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THE LEPIDOPTERA OF NEW YORK AND NEIGHBORING STATES

Primitive Forms
Microlepidoptera
Pyraloids
Bombyces

WILLIAM T. M. FORBES

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PREFACE

The work which follows is intended primarily to make easier the recognition of the Lepidoptera of the State of New York, and to assemble so far as possible the known data on their life histories, whether published or in the form of notes associated with the various collections. The work is, in a sense, a compilation, but largely of matter never before published. The keys, in particular, are for the most part a new venture, since for many groups of American Lepidoptera none have ever before been worked out; even the published keys to European forms are in need of revision. I cannot hope that my keys are perfect, but rather that, as a contribution in a new field, they may serve as a basis on which to build in the search for further knowledge.

The present contribution includes about half — the more primitive half — of the Lepidoptera. I have accumulated some data on the remainder, but it may be long before my notes are ready to publish.

My indebtedness is so general as to make a detailed acknowledgment impossible. Every one I have approached has helped me, and this means almost every Lepidopterist and the authorities of every considerable museum in the eastern United States. My first and greatest debt has been to the late Dr. John B. Smith, who, at Rutgers, encouraged me to begin such a piece of work, and gave me a great deal of valuable counsel. The signed contributions of Dr. Annette F. Braun and that of Mr. Carl Heinrich speak for themselves. No one else could have worked up the Nepticulidæ, the Coleophoridæ, and Lithocolletis. I have also been in almost continual consultation with them concerning many other groups where their names do not appear. I have consulted Mr. August Busck on every single group of the Tineids, and in most cases have followed his advice. I made the final draft of this memoir and prepared the drawings in the laboratories of Cornell University in 1919. I have incorporated a considerable part of the data published since that date, and have completely rewritten the section dealing with the Olethreutinæ and the Pterophoridæ; but it has not been possible to make the additions complete, nor to verify the New York records and adjust them to the new work. In the most important cases these have been noted in the text.

WILLIAM T. M. FORBES

Ithaca, New York
June, 1923.

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LEPIDOPTERA OF NEW YORK AND NEIGHBORING STATES

William T. M. Forbes

The primary purpose of this memoir is to describe the kinds of Lepidoptera, or butterflies and moths, which occur in New York, and those which, though they have not as yet been taken in the State, belong to the same fauna, as many of these will sooner or later be found within it. And a second purpose, of nearly equal if not of greater importance, is to indicate, as briefly as practicable, the main facts in the life history of each. Though monographs of certain isolated groups are available, there is no work dealing comprehensively with the American forms of this interesting and economically most important order.

As a measure of economy, colored figures, bibliography, and references are omitted. These appear unnecessary since W. J. Holland, in *The Moth Book*[1], provides colored figures of a large proportion of our more conspicuous species; while Barnes and McDunnough have a full bibliography nearly ready for the press, and Dyar's *List*[2], already published, furnishes a convenient index to the literature.

Every part of this memoir has been made as concise as possible without sacrifice of clearness. For this reason two types of keys are used. The one in which the categories are indicated by successive indentation is most convenient for quick reference, and is employed wherever practicable. In the case of very bulky keys, however, such as the keys to the families, and the one to the species of Tortricidæ resembling Eucosma, a more compact arrangement has proved necessary. Descriptions of genera and species have been reduced to skeletons, in the manner customary in zoological publications. Dimensions are given in millimeters: this is the more convenient unit in the case of the small forms; in the larger it is easily remembered that 25 millimeters equals 1 inch. Dates and distributions are approximate only, but as accurate as can be given with the material at hand.

As to nomenclature, the author has followed the tradition of usage more closely than any particular code, though such rules of usage as are almost universally accepted have been followed even to the upsetting of a few familiar names. In any disputed case the more familiar name is used. Other names which have gained currency are noted in parentheses. Names of varieties and races, so far as they appear to indicate a real difference, are noted, the more important ones in separate paragraphs, though without a number, the less important by casual phrases in the description of the species to which they belong.

[1] Holland, W. J. The Moth Book, p. 1–479. 1903.

[2] Dyar, Harrison G. A list of North American Lepidoptera and key to the literature of this order of insects. United States National Museum. Bul. 52: 1–723. 1902.

TAXONOMY

This is not the place for a monograph on the laws of nature, but the following outline will make clearer the writer's point of view as to the status of the forms discussed.

A species is considered to be: *A group of individuals separated from all others by tangible characters, breeding freely among themselves, but not with other individuals.* Fifty years ago this would have been sufficient. Now that the continuity of evolution has become obvious, we must recall that at some time any given species was coming into being, was being set off from its relatives, and was acquiring its characteristic property of not interbreeding with them. During such a period, which may conceivably have been long or short, the species would be imperfectly defined; individuals would interbreed with their cousins, but more and more rarely, and with imperfect fertility; and the various strains would be acquiring adaptations to new environments or climates, which would reduce the probability of intermating. And along with all this, differences of structure would be developing, distinguishing them to the human eye. In fact, many groups are now in this intermediate state, as witness the asters and the violets in the plant kingdom, and the *Apanteses* and the *Euxoas* among the Lepidoptera. Further, it is often, and in the Lepidoptera usually, unknown, to what point this isolation has reached; so we must use our best judgment in deciding what is a species and what a mere variety in any given case.

In order to make clearer the relationships of animals, species are grouped in a series of successively larger categories: *genus, family, order, class,* and *phylum* (*subkingdom*), within the animal *kingdom.* Besides these, in groups as large and as complexly related as the insects, intermediate groupings are employed: *subgenus* for a group of species within a genus; *subfamily, suborder,* and *subclass* similarly. *Superfamily* is used to designate a group of families[3], and *tribe* for a group of closely related genera. The values of these categories are really arbitrary, and there has been a continual tendency to split groups; in fact, the superfamily of the present day is smaller than the genus of Linnæus (1758). As to the genus, however, we have an imperfect criterion. Member of a single genus (on the average) produce hybrids, but sterile or of low fertility; members of different genera do not. Even here we find Nature draws no sharp lines, for, in isolated favorable cases, hybrids have been produced between widely different animals, though such always seem destined to an early death, in an embryonic stage.

In the course of the splitting of groups just mentioned, it is the practice to preserve the original name for one of the sections into

[3] Some early authors call this a tribe.

which an earlier category is divided. In the case of a tribe or larger group, whose name is derived from that of a genus, the subdivision in which that genus remains holds its name. When, however, a genus is divided, a species typical of the genus is taken (the type), which shall always be included in the genus retaining the old name. In many cases the proposer of a genus has designated the type; in others, the selection has been left to a later worker, and there is a good deal of confusion as to its selection. This confusion has been the basis of most of the changes of name of familiar insects with which the worker on Lepidoptera is cursed.

In the present memoir we are dealing with part of a single order, the Lepidoptera, belonging to the class Insecta. The suborders, superfamilies, families, subfamilies, tribes, genera, subgenera, and species are all systematically arranged in the text, and need no further explanation.

VARIATION

A species is, next to an individual, the most fundamental unit of living nature; but species themselves are not homogeneous. For intercrossing, which tends to bring things to an average, is offset by variation, which is continually producing new forms.

Although not as a rule striking, and often ill-defined, the most fundamental subdivision of a species is the *race* (also called *subspecies,* or *variety,* as that word is used by many German and English workers); these are forms isolated by difference of locality or habitat. Races are more or less clearly defined according to the amount of intercrossing between them; and this, in its turn, is a function of both the distances involved and the mobility of individuals. Some stocks, also, appear to be inherently more variable than others. So an active species, like *Vanessa cardui,* has few races, though its distribution is almost world-wide; while in the case of some Lycænas and Haploas, each patch of ground has its local form — a little race — distinct from those around it. Such minute races are known as *strains.* In general, races are distinguished from each other by a large number of minute characters, none of which are wholly constant, so that occasionally there will be found, in any region, forms that belong rather to some other race. Races breed true, at least so long as their environment remains constant.

Another type of variation is *seasonal.* Many species have more than one generation a year; and in that case specimens from one season are often recognizably, and sometimes strikingly, different from those of another. This variation is usually a response to the weather, wholly or in part, so that it is not very rare for a form normal, perhaps, in the spring, to appear in a cold summer, or in a cold breeding cage, or even erratically if the individual larva has grown up and trans-

formed in abnormal surroundings. In the period of change from larva to pupa, specimens have been found to be most sensitive to external conditions, but the effect may be perceptible throughout larval life.

Thirdly come *food-varieties,* which are, perhaps, sometimes of the same nature as strains, sometimes as seasonal forms, but associated with differences in larval food. Aside from the minor cases of stunting from unfavorable food, and of exuberant growth with favorable, there is at least one case, that of *Halysidota*[4] *tessellaris,* where definite forms are associated with different food plants.

Mendelian forms, like races, breed true so long as pure. They do not need to be segregated locally, but act as units in inheritance. Some are dominant, their characteristics appearing in every individual that carries the factor that causes them; others are recessive, only appearing in those individuals that happen to inherit the proper factor from both parents. The latter, of course, may be covered up for a series of generations, and then suddenly appear as the result of a favorable mating. The details of this type of inheritance are exceedingly complicated, and are explained in several recent textbooks on heredity. Striking cases of inheritance of this type exist in the genus Apantesis. In *A. nais* it involved the black costal edge, the black-spotted collar, the black face, the red hind wings, and some other characters, each inherited independently of the others. Such Mendelian characters are supposed to have arisen by an abrupt change, or *mutation,* in the germ of some individual. Many cases have been studied in the Lepidoptera. Mendelian forms, as well as minor races, are often called strains on account of their tendency to breed true.

Many variations, lastly, are produced wholly or largely by external causes; and we are ignorant of the true nature of many. These are generally known as *varieties* ("aberrations" of Staudinger, Jordan, and their followers), or, if rare and widely different from the normal form, as *aberrations.*

Monstrosities are deviations in structure from the norm of a species. They may be slight, or so radical as to be incapable of continued life; and may be a result either of an inherited factor, or of some external influence in an early stage. Mere mutilations are not considered monstrosities.

It is customary to use as the name of a species its genus and species names. The former is a noun in the singular, and of Latin form; the latter, when an adjective, is made to agree with it in gender. All names of genera are written with a capital, and in entomology it is customary nowadays to write those of all species with a small letter. To

[4] This is Hübner's original spelling of the name, justified by its derivation from the Greek.

this combination the name of the author who first described or figured the species is often added. For a *race,* its name (with that of the author if desired) is added after the species name; and for a seasonal form, or named variety, or aberration, or Mendelian form, its name is added, preferably prefixing the notation *variety* (abbreviated *var.* or *v.*), *aberration* (*ab.*), or *form* (*f.*), to distinguish it from a race.

As an example, to give fully the name of the early spring form of the *Azure Blue* we write *Lycæna argiolus pseudargiolus* f. *lucia* Kirby.

There is often uncertainty as to whether a given form is a species or a race. I have listed such forms according to what appears to me their most probable status, sometimes noting the uncertainty.

The following striking cases of variation are listed from the Lepidoptera of our fauna:

Races (Local forms):

Argynnis aphrodite (Atlantic), *alcestis* (Mississippi Valley), and *cipris* (Rocky Mts.).
Basilarchia astyanax (Atlantic), *arthemis* (Northeastern), *rubrofasciata* (Northern Rockies), and *arizonensis* (Arizona).
Cercyonis pegala (Gulf strip), *alope* (Eastern), *nephele* (Northeastern), and *olympus* (Mississippi Valley).
Lycæna argiolus (Europe), *pseudargiolus* (general eastward), *nigra* (Appalachians), etc.
Lycæna couperi (Northern), and *lygdamas* (Appalachians).
Pholus satellitia (Antilles), and *pandorus* (Northeastern).
Hemaris thysbe (Northern), and *floridensis* (Southern).
Zale lunifera (Atlantic), and *lineosa* (Mississippi Valley).
Automeris io (Northern), and *lilith* (Florida).
Eacles imperialis (Northern), and *nobilis* (Texas).

Seasonal forms:

Papilio marcellus (early spring), *telamonides* (late spring) and *lecontei* (summer).
Phyciodes tharos (summer), and *marcia* (spring).
Polygonia comma (winter), and *dryas* (summer).
Polygonia interrogationis (winter), and *umbrosa* (summer): these two imperfectly seasonal.
Hemaris diffinis (summer), and *tenuis* (spring).
Lycæna pseudargiolus lucia (partly local), *marginata, violacea, pseudargiolus.*
Eutrapela kentaria (spring), and *glaucaria* (summer).
Eutrapela alciphearia (spring), and *ornata* (summer).
Peronea minuta (summer), and *cinderella* (winter).

Sexual forms (a few striking examples):

Argynnis diana (male red, female blue).
Argynnis idalia (male with red marginal spots, female with white).
Chrysophanus thoë (male purple, female red and black).
Lycæna pseudargiolus (female only with black border).
Lycæna comyntas and *scudderi* (male blue, female black).
Pieris rapæ (female with an additional spot).
Eurymus philodice and *eurytheme* (female with spots in border).
Pamphila brettus and *zabulon* (male tawny, female black).
Callosamia promethea (male black and diurnal, female red and nocturnal).
Automeris io (male yellow, female dark).
Eacles imperialis (male with red patches, absent in female).
Estigmene acræa (male with yellow hind wings, female white).
Apantesis phalerata (male with pale hind wings, female with red).
Alypia langtonii (eastern male with two white spots on hind wing, female always with one yellow).
Tarache terminimacula (pattern different in sexes).
Biston quernaria (male dark and short-winged, female light and long-winged).
Erannis tiliaria (male yellow and brown, female black and white, and wingless).
Nymphula maculalis (male black and white, female normally gray).
Nymphula seminealis (male with white submarginal band).
Acrolophus mora (male blackish, female brown).
Prionoxystus robiniæ (male with yellow hind wing, female gray).
Prionoxystus macmurtrei (female many times larger than male).

Dimorphism not wholly sexual (so far as known, Mendelian):

Eurymus species (white and yellow females).
Eurymus eurytheme (both sexes yellow or orange).
Pieris rapæ (white), and *novæangliæ* (yellow male).
Papilio turnus (yellow), and *glaucus* (southern black female).
Pamphila hobomok (tawny), and *pocahontas* (black female).
Pamphila massasoit (yellow below), and *suffusa* (dark below).
Apantesis nais (red and yellow females); also many less striking cases in the genus.
Catocala palæogama and other species of *Catocala* (black-banded forms).
Deilinea liberaria (tawny), and *helena* (brown-banded).
Aplodes brunnearia and *bistriaria* (green and brown forms).
Nymphula icciusalis (yellow or brown ground).
Nymphula maculalis (dark or spotted male; white or gray female).

The so-called species of *Haploa,* except *clymene,* should perhaps be put in this category.

In the west we have also the white and yellow males of *Estigmene acræa,* and the yellow and black forms of *Papilio polyxenes.* There are many cases of dimorphic or polymorphic larvæ, where the moth varies but little; the following are conspicuous cases, the alternative color being usually green and brown or black.

Dimorphic or polymorphic larvæ

Papilio polyxenes (light or dark).
Vanessa cardui (white to black).
Deilephila lineata (green, checkered, or black).
Lapara harrisii (green and white, or brown).
Sphecodina abbotii (green spots on brown, or checkered).
Herse cingulata (green or brown).
Sphinx chersis (green or pink).
Several other Sphingidæ (green or brown).
Tropæa luna (green or reddish head).
Eacles imperialis (green, tawny and black, or black).
Citheronia regalis (green, blue, brown, or rose).
Acronycta (many species).
Noctua c-nigrum (brown; in summer often green).
Leucania unipuncta (brown or black).
Cosymbia lumenaria (green and striped, or brown and checkered).
Lygris diversilineata, and many other geometers (green or brown).
Cucullia asteroides (green, or yellow and white).

Moths of high variability

Telea polyphemus (tawny, yellow, brown, or olive).
Automeris io (female).
Feralia jocosa (green, cream, or brown).
Brotolomia iris (amount of green and purple).
Lithacodia muscosula (green or gray).
Metrocampa prægrandaria (green or gray, both fading to yellow).

The instability of green and purple pigments is notable. Most species with these colors fade rapidly while still alive, sometimes even before emergence from the pupa.

RELATIONSHIPS

It is impossible to represent the true relationships of the Lepidoptera in a linear arrangement. In general, the main branches of the order have been placed according to their degree of specialization as a whole; but where development has been in such varied directions this is a

more or less arbitrary process. Thus the butterflies (Rhopalocera) have been placed at the end, as furthest developed of all, but the relationships of the base of their stock are clearly with the Cossidæ —

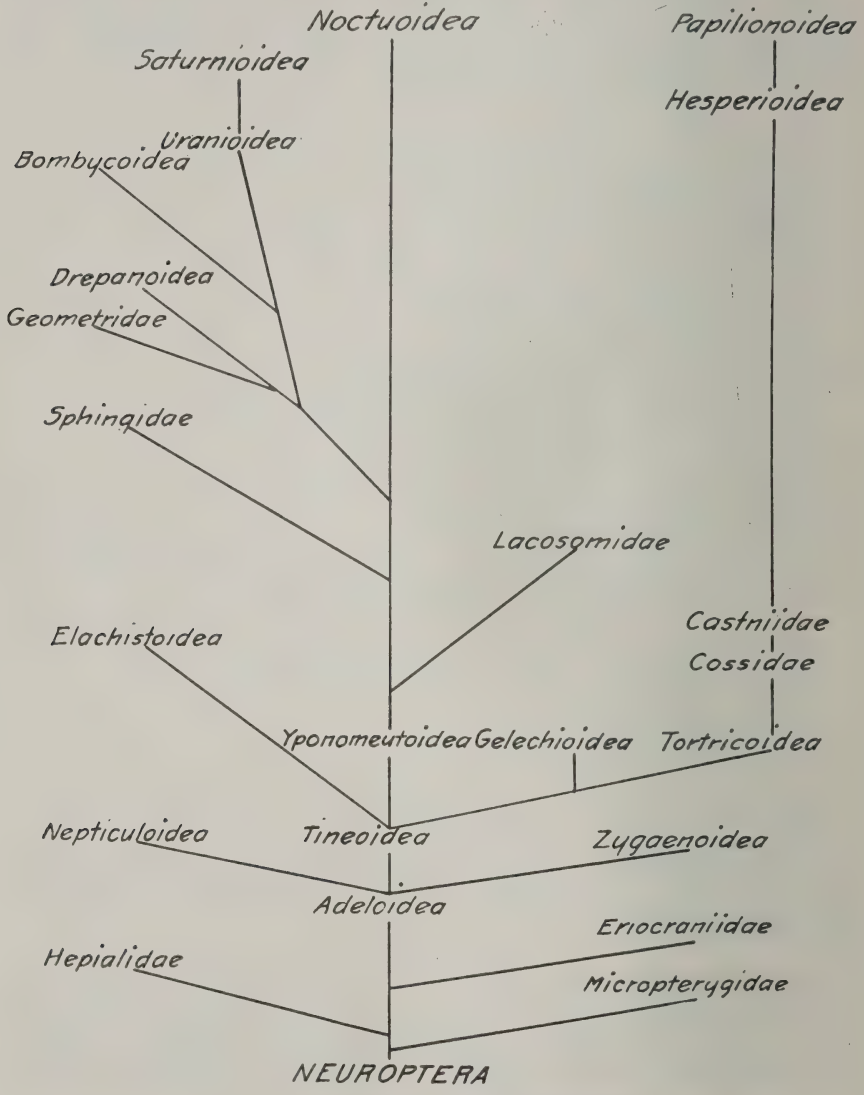


FIG. 1. GENEALOGY OF THE LEPIDOPTERA

At the time of preparing this chart I was unable to place the Pyralidoidea. I now believe they should be derived from the Yponomeutoidea

an undoubtedly early type; and the lowest butterflies are but little removed from the highest of the Cossid type (the tropical American and Australian Castniidæ). In certain ways (as in the thoracic sclerites) even the highest butterflies show their primitive character. For such reasons some recent authors have inserted the butterflies next to the Cossidæ, and have put the Euchromiidæ or Noctuidæ at the pinnacle of the order. It should be remembered, in any case, that each is the terminal of a long line of separate descent; and a true arrangement would put them side by side rather than one above the other.

The diagram (fig. 1) indicates the writer's impression of the probable relationship of the families. The Jugatæ are undoubtedly an early type and approaching extinction. The Frenatæ can scarcely have descended from either of the three Jugate families, but must have come from a stock with the haustellum, ovipositor, and tibial spurs of the Eriocraniidæ, and the larva of the Hepialidæ. The earliest type of Frenate must have been much like Incurvaria, but doubtless larger, and with characters that have been lost in all the aculeate genera, but survive in the lower Tineidæ, such as Acrolophus and Scardia. From such a type the Tineine superfamilies have arisen as separate branches, the Tortricoidea perhaps as another branch, or in association with the Yponomeutoidea, and the Pyraloids and higher Frenatæ doubtless from a common stem with the Yponomeutoids, but diverging very early.

In a similar way, the individual superfamilies of the Macrofrenatæ must have separated very early; but the Drepanoidea, Uranioidea, Saturnioidea, and Geometroidea may have hung together a short time after the Sphingidæ and the Noctuoidea had become distinct.

As to the internal evolution of the superfamilies, little is clear in most cases, save that the author has aimed to arrange the families in order, from the more generalized to the specialized. In the noctuid group the relationship is a little clearer (fig. 2), the connection between Notodontidæ, Liparidæ, and the remaining families being through the exotic families Hypsidæ and Pericopidæ. The Hypsidæ have the primitive venation of the Liparidæ but have preserved the ocelli and the tongue. The Dioptidæ have the trifid venation and the free **Sc** of the Notodontidæ, but the tympanum is of a primitive type from which the others may be derived.

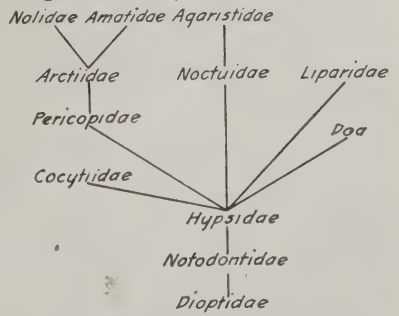


FIG. 2. GENEALOGY OF THE FAMILIES RELATED TO THE NOCTUIDÆ

In the butterflies, the line of descent through Hesperiidæ and Papili-

onidæ to the Pieridæ is clear, and the Nymphalidæ are certainly a direct offshoot of the Pieridæ; but the attachment of the Lycænidæ is less certain.

DISTRIBUTION

The life zones of New York and the adjacent States are:

1. Arctic-alpine
2. Hudsonian
3. Canadian
4. Alleghanian or Transition
5. Carolinian or Upper Austral
6. Austroriparian or Lower Austral

In northeastern North America, the Arctic-alpine zone is confined to the true Arctic region and the tops of the White Mountains of New Hampshire. The Green Mountains, the Adirondacks, Mt. Katahdin, the Catskills, and even some lesser peaks have stray alpine species, but south of the Catskills there are none. The bleak coast of Labrador belongs to this zone, but the inland shows the wooded character of the Hudsonian zone.

The Hudsonian zone is marked by an average midsummer temperature of about 50° to 57°F., and by the dominance of fir, spruce, and tamarack. It covers the continent from the Laurentians north, and shows on the higher levels of all our mountains, even south to North Carolina. Characteristic of its northern portion are *Brenthis montinus, Polygonia gracilis,* and *Alypia langtonii.* South of the Mohawk Valley its Lepidoptera have not been recognized as distinct from the Canadian forms.

The Canadian zone has an average temperature of 57° to 64°F, and also is a great area of conifer forest, but one readily giving place to many deciduous trees. While characteristic of Canada and northern Maine, the most fully cultivated parts of Canada, including the sheltered inner half of Nova Scotia and all of Quebec and Ontario south of the Saguenay and Laurentians district, belong to a warmer area. South of Canada, most of the mountains of New England and New York, as well as all the cooler summits of the Appalachians, belong to this zone. The peat bogs and swamps at lower levels often show the fauna of this zone, especially where tamarack and the heaths (Labrador tea, etc.) are dominant, rather than the southern white cedar. Characteristic Lepidoptera are *Basilarchia arthemis,* (which runs into the Transition), *Chrysophanus epixanthe, Pieris oleracea* (formerly wide spread in the Transition also), *Eurymus interior, Polygonia faunus,* and others.

The Transition, or Alleghanian, zone is typical of New York, and the data of seasons and broods are designed especially to apply to this district. In this zone deciduous trees are quite as common as conifers, and the northern beech and southern chestnut overlap. It can hardly be said to have a special flora and fauna, but only a special

combination of forms. It covers the area with a summer temperature of 64° to 72°, or a total growing heat (sum of daily excesses over 43°) of 10,000° to 11,500°F.

The Upper Austral, or Carolinian, zone has a summer temperature range of 72° to 79°, or a total growing heat of 11,500° to 18,000°F. It is the most northern area for many characteristic species: *Papilio marcellus* (and its food, the papaw), *cresphontes, philenor, Pieris protodice, Eurema nicippe, Euptoieta claudia, Chlorippe clyton* and *celtis* (with Celtis, their food) and others, besides a large number of skippers. The most striking of the characteristic moths are *Herse cingulata, Phlegethontius sexta,* and *Citheronia regalis.* Besides a part of the Mississippi Valley, it embraces the extreme southern part of Ontario and the Great Lakes strip of New York; but on the Atlantic Coast it is more restricted, including the major part of Virginia and Maryland and sending long arms along the coast and up the rivers. Distinctively Austral forms even reach Albany on the Hudson, Springfield on the Connecticut, and Boston along the coast. Part of the Austral species named are strong flyers, and also appear sporadically far out of their range, where they rarely or never breed.

The lower Austral zone, or Austroriparian, scarcely enters the region under discussion, but can be considered to include the coast of Virginia, and possibly isolated points in Maryland, and Cape May, New Jersey. Its summer temperature is over 79°F., and its total heat is 18,000°. Most probably in this case the total heat is the controlling factor.

Only a few lower Austral species are recorded in this monograph, either those that are particularly striking or those that have been often reported as strays in the North. In fact, our part of the area has scarcely been studied.

South of this there is a series of tropical zones, which do not concern us.

The control of humidity is, in our region, less striking, as it limits itself mainly to the setting off of the very damp off-shore islands, where ground vegetation is rank and trees are often gnarled and stunted. This strip has been so changed by man — largely through fires and sheep pasturing — that it is no longer possible to say what its natural stock was; but it is particularly marked by a wide northward range of species otherwise sub-tropical, like the *Prenes* and *Prionapteryx nebulifera,* mixing side by side with the boreal forms. This is perhaps because the blanket of fog masks the severity of the winters; an effect that reaches an extreme on Nantucket, whose indigenous Lepidoptera have now largely disappeared because of sheep pasturing.

There is a marked difference between the Mississippi Valley forms and those of the Atlantic Slope, but this may be due as much to the barrier of the Appalachians as to any difference in climate. This subdivision shows clearly only in the Transition and Upper Austral zones. West of our territory there is an arid subdivision, which invades Illinois in a few isolated stations. The sand region of the Coast and in the vicinity of Albany and Peru, New York, forms a sort of artificial arid subdivision, where live a few characteristic western species. The *Synedas* may be examples; also *Plagiomimicus* and its relatives.

The control of physical barriers is best marked by the confining of the colder-zone insects in New York to certain of the higher peaks, and by the wider barriers of the St. Lawrence Plain (which stops *Cœnonympha inornata,* for instance) and the Mohawk Valley, which is perhaps the barrier for typical *Pieris oleraca,* and marks a varietal difference in certain geometers. These barriers, like that of humidity, are much less effective with us than in the Western States.

Distribution may also be viewed on a much smaller scale. Each spot, or station, where a colony of a species occurs, has its own peculiar characteristics of moisture and average temperature, and its own surrounding barriers, more or less effective: of these factors moisture is the most obvious variable, but fog or sunlight, close or easily drained soil, high or low water-table, each has an effect at least on the available food-plants and on the possibilities of pupation of the insect. Standing water has its own characteristic types (largely Nymphulinæ), and even running water has its peculiar species (*Elophila fulicalis*). Characteristic of the swamps are many Noctuids, a large part of them recognizable by their striated wings, simulating dead grass or reeds; as, for example, *Leucania pallens* and the *Borolia* group, the Nonagrias and their kin, *Senta*, *Ommatostola,* and *Euchalcia venusta,* as well as the species of *Prenes*, *Chrysophanus epixanthe*, *Darapsa versicolor* (which can only transform in wet moss), the *Raphipteras, Epimartyria,* and many others. Dry, open fields are relatively barren of Lepidoptera, but even they are the principal home of the Crambinæ.

It is a general rule that species in their most favorable local conditions will range far beyond their principal zone, and at optimum conditions of temperature will invade abnormal types of environment. This doubtless explains the curious mixture of northern and southern types, for instance, in the peat-bogs, where such arctic genera as Œneis find their only chance in the Canadian zone, and where the typically southern Exyras invade New England. So also the Nymphulinæ, which are richly developed in the tropics, find protection from the frost only in our ponds and streams, where they winter below the ice.

STRUCTURE

Imago

The *head* (fig. 3) bears a pair of antennæ, normally long and conspicuous, a large, minutely facetted compound eye on each side, in many cases with a minute simple eye, or ocellus, just above it; and the mouth parts, which include the labrum, a pair of mandibles, a pair of maxillæ, and the labium.

The *antenna* is composed of a large number of segments, most often from twenty to fifty. The basal segment, the *scape* (fig. 3), is much larger than the others; the second, or *pedicel*, contains a peculiar sense organ; and the remaining segments comprise the *flagellum*. Frequently the distal segments of the flagellum are thicker and shorter, forming a *club* (figs. 5 to 7). In this case the slender part of the antenna is the *shaft*. The club is usually without scales on the under side, even when the shaft is fully scaled, and varies in form and structure.

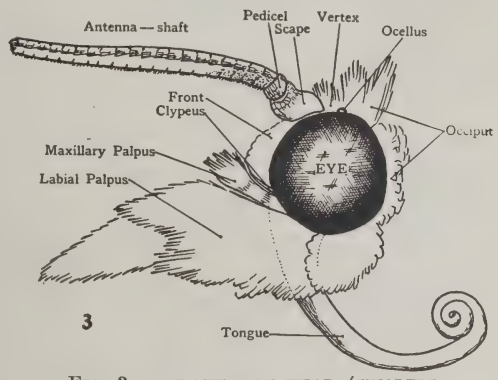
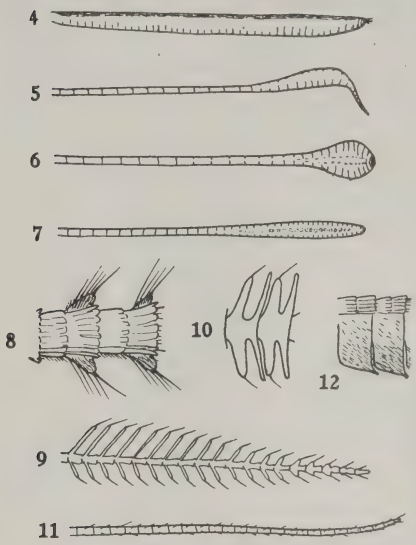


FIG. 3. SIDE VIEW OF HEAD (THOLERIA REVERSALIS)

In the primitive forms the club is fusiform (fig. 4) gradually thickening and as gradually tapering to a point. It may be bent in the middle, or hooked, as in the skippers (fig. 5), and the hook may vary in stoutness and length, and in the number of segments involved. The higher butterflies, which have no hook, often show, by the asymmetry of the terminal segments, how the hook has become vestigial. In some forms the club is not sharply set off from the shaft (as in Feniseca), and in a few Satyrids its past existence is indicated only by an abrupt change in the color of the flagellum. Antennæ which are not clubbed usually taper to a point; those which have lost a club usually end bluntly.

The normal antenna is partly clothed with scales, which typically form two rings about each segment or two bands on the dorsal side (fig. 8), but always leave more or less extensive sensory areas covered with minute hairs, which by contrast appear naked. In many lower forms these bare areas are inconspicuous, but as a rule the under half, more or less, of each segment is naked. Lepidoptera with clubbed

antennæ usually have the shaft completely scaled, and the sensory area confined to the club, which it may completely cover. In this case there are often special areas marked by pits or grooves separated by longitudinal ridges, and containing special structures. When each segment has a quadrangular extension on the under side covered with these sensory hairs, the antenna is called *laminate* or *prismatic* (fig. 12); when the segments are extended sideways in little teeth, the antenna is *serrate* (fig. 8); and when there are long branches, it is *pectinate,* or, in extreme cases, *plumose* (feathered). If there is but one series of such branches, it is *unipectinate* (a rare condition); if there are two, it is *bipectinate* (fig. 9), and when each segment bears two pectinations or branches in each row, it is *doubly bipectinate,* as in the Luna moth and its kin, (fig. 10). In doubly bipectinate antennæ the pectinations are often alternately long and short, or thick and thin. Where there is a long, strong pair of bristles on each segment, the antenna is *ciliate* or *bristled* (fig. 11); if the bristles come in distinct tufts, it is *fasciculate,* but if they are numerous and scattered evenly it is *pubescent* (fig. 87). In many sphinx moths, especially males, the bristles are in two vertical rows on each side of each segment, whose tips curve and meet so as to seem to form loops. The scales on the antenna usually form two transverse rows on each segment (fig. 46); sometimes they are scattered (fig. 48); and in the Saturniidæ and many butterflies they are either wholly absent, or fugitive, except on the two basal joints.



FIGS. 4–12. TYPES OF ANTENNÆ

4, Fusiform; **5,** clubbed and hooked; **6, 7,** clubbed; **8,** serrate and fasciculate, dorsal view; **9,** bipectinate; **10,** doubly bipectinate; **11,** simple and ciliate; **12,** laminate or prismatic, side view

The eyes vary in size and shape. Typically they are circular in side view (fig. 3), and about as wide as the distance between the two eyes as seen in a front view. Often the eyes are much narrower, and much higher than wide (elliptical, fig. 271) or even concave on the posterior margin (reniform). In the Lycænidæ they appear as if cut

off behind, and there is a slight notch in the upper front side, where the antenna arises. Often there are minute straight hairs arising between the facets, in which case the eye is called *hairy* (fig. 14). A *lashed eye* is one in which bristles arise around the edge and curve over it (fig. 15), especially in front below the antennæ, and behind. The facets are usually finer and more numerous in nocturnal forms.

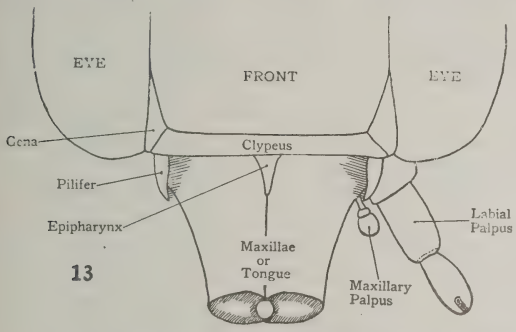


FIG. 13. FRONTAL VIEW OF LOWER PART OF HEAD, DIAGRAMMATIC

The simple eyes, or ocelli (fig. 3), when present, lie behind the root of the antennæ. They vary in size and in distance from the eye, and are often absent, as in all butterflies.

The portion of the head between the eyes in front is the *front*, called *clypeus* or *clypeus posterior* by some entomologists (figs. 3, 13), and

FIG. 14. HAIRY EYE (HIGH MAGNIFICATION)

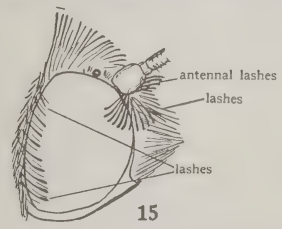


FIG. 15. LASHED EYE (MODERATE MAGNIFICATION)

the sharp projecting ridge along its lower boundary is the true *clypeus*. The head between the eyes above is the *vertex;* and the back of the head, behind the eyes and ocelli, is the *occiput* (fig. 3).

The *labrum* of the imago (fig. 13) is a three-lobed structure. The middle lobe merely closes the space between the bases of the maxillæ; the two lateral lobes are the *pilifers*, and project across the base of the tongue, each bearing a tuft or row of bristles, which provide important characters in the classification of the Sphingidæ.

The *mandibles* are almost always rudimentary or absent, difficult to find, and unimportant (fig. 49). In Epimartyria alone there are regular biting mandibles; but in a dried specimen they are usually difficult to see without dissection.

Each *maxilla* (save in Epimartyria) consists mainly of a slender coiled portion, the *galea* (figs. 37, 49). The base of the maxilla in many cases bears a two- to four-jointed sensory organ on the outer side, the *maxillary palpus*. The two maxillæ are grooved on their inner sides and hooked together to form a hollow sucking tube. Together they are known as the *tongue*.

The tongue may vary in size and stiffness. When it is shorter than the head in slender moths, or shorter than the thorax in heavy and strong ones, it is considered rudimentary in systematic work, as it is in the Pyralids if it is not large enough to show between the palpi when coiled up. It has sensory bristles at the tip and often bears scales at the base, but as a rule the base is naked. In certain noctuids as *Alabama argillacea*, the bristles at the tip form a rasping organ with which the rinds of fruits can be pierced. A few moths lack the tongue. The maxillary palpi are conspicuous and five-jointed in the lowest moths, and are folded at rest, being more or less movable. As one goes up the scale they become smaller, till in our Noctuidæ they are mere microscopic, scaly tufts, and in the butterflies and the Geometridæ they are unrecognizable.

The *labial palpi*, often called merely the palpi, arise on each side behind the base of the tongue (in the lower forms from a small labium

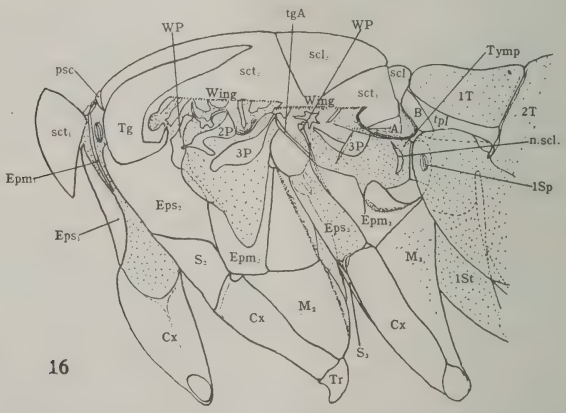


FIG. 16. LATERAL VIEW OF THORAX, DENUDED, WITH WINGS AND LEGS REMOVED

Al, alula of hind wing; **B**, entrance to tympanic bulla; **Cx**, coxa; **Epm**, epimeron; **Eps**, episternum; **M**, meron; **n. scl.**, nodular sclerite of tympanum; **2P, 3P**, parapter (**3P** is the "subalar sclerite"); psc, prescutum; **scl**, scutellum; **sct**, scutum (sct is the patagium); **1Sp**, spiracle of first segment of abdomen] **S**, sternum (thorax) **1St**, sternite of first segment of abdomen; **Tg**, tegula; **tgA**, tegular arm; **tpl**, tergo pleural groove; **Tymp**, membrane of tympanum; **Wp**, wing process of pleurites; (Th subscript numbers, 1, 2, 3, indicate the segments of the thorax)

in the higher ones directly from the surface of the head), and extend forward on each side of the base of the tongue. They are composed of three joints, and are densely clothed with scales, which are usually thicker on the upper and especially the lower side than on the lateral faces, giving them a more or less blade-like form. If the palpi extend nearly straight forward, they are called *porrect*; if the scaling on the end of the second joint ends abruptly with a slight tuft, they are *clavate* (fig. 244). In the Tineidæ they usually have strong bristles besides the scales and soft hair; but this is rarely the case in higher families of moths.

The *thorax* (fig. 16) is composed of three segments, *prothorax, mesothorax,* and *metathorax,* each provided with a pair of legs, and the last two each with a pair of wings. The *legs* (fig. 17) are segmented, the segments being, named in order beginning at the base: *coxa, trochanter, femur, tibia,* and five *tarsal segments.* The coxæ of the middle and hind legs are partly fused with the body and divided into an anterior part, the true coxa, and the posterior part, the *meron,* by a suture. The trochanter is minute. The femur is rarely modified but often bears long hairs, even when the rest of the leg is scaled. In the males of the Catocala group, there is a minute spine, the *gonyodon,* on the apex of the fore femur.

The fore tibia bears a leaf-like structure on its inner side, the *epiphysis*; this is clothed with stiff bristles, and serves mainly to clean

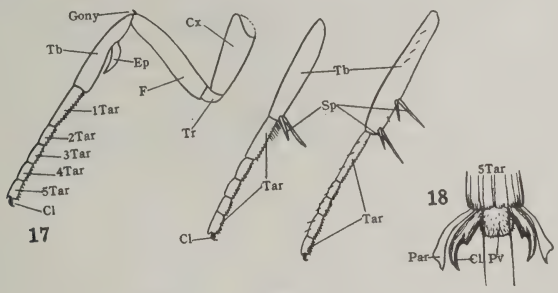


FIG. 17, 18. LEGS AND FOOT

Legs: **Cl**, claw; **Cx**, coxa; **Ep**, epiphysis; **F**, femur; **Gony**, gonyodon; **Sp**, spurs; **Tar**, tarsus; **Tb**, tibia; **Tr**, trochanter

Foot: **Cl**, claw; **Par**, paronychium; **Pv**, pulvillus; **5 Tar**, body of fifth segment of tarsus

the tongue and antennæ. The higher butterflies and a very few moths have lost the epiphysis. The tibia also sometimes bears one or more enlarged spines or claws at the tip. The mid and hind tibiæ have a pair of *spurs* at the tip — scaled, spine-like structures articulating with

the tibia. The hind tibiæ have a second pair, usually near or below the middle.

In many butterflies and Noctuidæ the tibiæ bear spines similar to those on the tarsus, but less regularly arranged. Males frequently have tufts of sex-hairs, and in many cases the tibia is grooved to protect them. On the hind legs of many Ennomid geometers, the tibia is largely hollow and the tuft almost completely enclosed, though its point of attachment is regularly on the exterior.

The last five segments constitute the *tarsus,* or foot, the most basal being the *metatarsus.* This segment is usually much larger than the other four, and occasionally bears special tufts or spines. The final segment (fig. 18) ends in two articulated and curved *claws,* and an adhesive pad between them, the *pulvillus.* On the inner side of each claw, toward the pulvillus, there is often a sensory membrane, the *paronychium.* These are large and conspicuous in the Sphingidae, and are often forked. The pulvillus is rarely minute or absent.

The tarsal segments are also armed with smaller spines, which usually form three or four rows on the ventral surface, but sometimes are dorsal also, or gathered into tufts at the tips of the segments. They are sometimes concealed in the scaling, though rarely absent. Often they are wanting on the base of the metatarsus and are differently arranged on the last segment. In the family Nymphalidæ, the fore legs are reduced and not used for walking. They have no claws and the segments are more or less fused, but the general appearance of a leg is retained. The male carries the reduction slightly further than the female. The Erycinidæ and Libytheinæ show less reduction in the male and none in the female: in their males the tarsus is very small and without claws, and the tibia extends beyond its insertion as a sort of claw. In the males of the Lycænidæ the fore legs are still less reduced; while the leg has lost its claws, it is functional, ending either in a single claw-like spine or a group of spines. In the Herminiinæ the leg is more curiously modified in the male, although perfectly normal in the female. The coxa may be very long and movable (it is never as closely fused with the body in the fore leg as in the middle and hind ones). The trochanter is sometimes lengthened. The femur tends to be weak, the tibia and first joint of the tarsus, either or both, may be hollowed out to a mere shell, enclosing enormous tufts of hair; and the tarsus is sometimes minute. The leg as a whole may be enlarged or reduced. Many moths, especially geometers, bear a tuft of fine hair at the junction of the hind tibia and femur, or on the tibia near the base; this is also often contained in a hollow in the tibia, and in some cases is lost at copulation. In the Acidaliinæ the tibia may be much enlarged to enclose it, or may be reduced, even to an extreme, while

the tarsus in these cases is usually reduced. In several exotic Acidaliinæ one of the spurs bears a comb which seems to be used in handling this tuft. Some species of Ptychopoda (Eois) have almost completely lost the hind legs. These modifications are confined to males, or are carried much further in males than in females. Besides these features spurs are often reduced or lost, and occasionally (Leucania, Nematocampa) modified in form. In the lower Tineina the tibial spines are represented by long, slender, but stiff bristles which may be either in regular rows or irregular. In some cases, as in Nepticula and Acrocercops, tibial spines are a conspicuous feature, but in the Œcophoridæ and others they seem to intergrade with the ordinary hairs. In some Sphingidæ and Plusiæ the spines at the base of the tarsus may form a distinct *comb* (fig. 17, middle leg).

The wings (fig. 19) are usually more or less triangular, the three

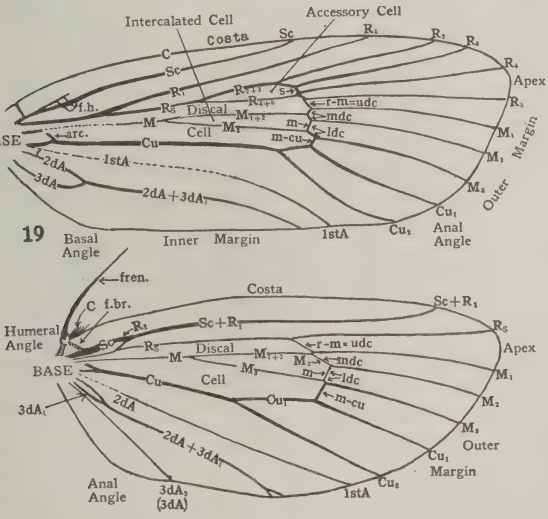


FIG. 19. WINGS (ACROLOPHUS POPEANELLUS ♂)

C, costa; **Sc**, subcosta; **R**, radius; R_1, R_2, R_3, R_4, R_5, branches of radius; R_s radial sector (usually merely labelled **R** in the hind wing); **M**, media; M_1, M_2, M_3, branches of media; **Cu**, cubitus; Cu_1, Cu_2, branches of cubitus; **1stA**, **2dA**, first and second anal veins; **3dA**, third anal vein; $3dA_1$, $3dA_2$, branches of third anal vein ($3dA_2$ of the hind wing is usually merely labelled **3dA**); **f.br.**, frenulum-brace (humeral); **arc.**, arculus; **S**, sectorial cross-vein; **r-m**, radio-medial cross-vein; **m**, medial cross-vein; **m-cu**, medio-cubital cross-vein; **udc**, upper discocellular vein (in this case the same as **r-m**); **mdc**, middle discocellular vein (in this case portions of M_1 and M_2); **ldc**, lower discocellular vein (in this case **M** and a portion of M_3); **fren.**, frenulum; **f.h., frenulum hook**

sides, *costa, outer* (or hind), and *inner margin,* and the three angles, *base, apex,* and *anal angle,* being indicated in the figure. Sometimes the inner margin of the fore wing is extended out near the base, forming a *basal angle,* or the costa of the hind wing may be similarly extended, forming a *humeral angle.* The wing is stiffened with a regular pattern of hollow rods, the *veins,* which are important when the wing is expanding, besides serving to stiffen the mature wing. These veins have a definite arrangement, based on that of the pupal tracheæ around which they form (see the figures). From the base of the wing there run out costal, subcostal, radial, medial, cubital, and some anal main stems. Of these the *costa* is simple and forms the front edge of the wing; the *subcosta* may be simple, but in a few low forms it forks once at the tip. The *radius* forks normally into five branches, primitively as shown in figure 40 but in various ways in the higher forms. Often part of these branches are lost, and in a few of the lowest species the first branch forks again (fig. 36). *Media* is three-branched, but usually the base of it is lost, and the branches are variously attached to the stems of radius and cubitus; when one is attached to cubitus, the latter is called *trifid* (fig. 425), when two, *quadrifid* (fig. 427), the upper median being always free or attached to radius. The middle branch of media, sometimes called the *independent,* is often weak or lost. *Cubitus* is two-branched, and is a very constant feature. The *anals* are somewhat uncertain in origin, but usually appear in low Frenatæ as three radiating veins, the first running along the principal concave fold of the wing. The first anal disappears in higher forms, leaving only the fold; the second is persistent; and the third tends to grow short in the hind wing, and to join its tip to the second, or even to disappear, in the fore wing. In the Jugatæ (figs. 31, 36, 40) the arrangement is more complex and not fully understood. This description, intended mainly for the fore wing, applies also to the hind wing of the Jugatæ. In the hind wing of the others the radius is only two-branched, and the upper branch fuses more or less, often almost completely, with subcosta, as indicated by the lettering of the earlier figures. Commonly $\mathbf{Sc}+\mathbf{R}_1$ is merely marked **Sc**, and $\mathbf{R}_s$, merely **R**. Besides these veins, which are based on tracheæ, there are certain cross-veins; the *humeral* (**h.**) at the base of the costa, often pushed to the base of the wing and so lost; the *sectorial* (**s.**), running across between the third and fourth branches of radius, and so enclosing the *accessory cell,* often lost by the fusion of the veins at that point; and the *discocellular,* running more or less irregularly from radius across media to cubitus, enclosing the *discal cell* ("cell") between it and the base of the wing, and supplying an attachment for the branches of media when the base of media is lost. The *arculus* (**arc.**) connects the media and the cubitus at the base of the wing, but shows clearly only in the

fore wing of the Jugatæ; and there is occasionally a cross-vein in the anal region. The discocellular is divided into four parts by the three branches of media: upper, middle, and lower discocellulars (**udc.**, **mdc.**, **ldc.**), and the false base of media-three (**m-cu.**). In the hind wing the humeral is usually replaced by a short spur from the base of the subcosta, which may not reach the margin.

The Jugatæ have a special lobe on the inner margin of the fore wing, the *jugum* (fig. 40). In the Hepialidæ this slips under the hind wing in flight and helps the wings to work together.[5] In the others it overlies the hind wing and is sometimes called a *fibula*. In most cases the wings are attached to each other by a bristle or group of bristles, the *frenulum*, which is attached to the base or the humeral angle of the hind wing. The frenulum either runs through a hook, the *frenulum hook*, attached to **Sc** near the base of the fore wing; or under a tuft of scales, the *retinaculum*, spreading up fanlike from near the base of **Cu**. The male almost invariably has a single frenulum running through a hook; the female has usually several bristles (the approximate number characteristic of the family) held merely by a retinaculum. In several groups (some Pyralididæ, some Pterophoridæ, Ægeriidæ, Euteliinæ) the frenulum of the female is also simple, but the hook is represented at most by a second tuft of scales. In many forms there is no attachment between the wings, which merely overlap; in a very few (Ægeriidæ, Pterophoridæ) the inner margin of the fore wing and the costa of the hind wing bear series of recurved spines, which interlock (fig. 223), the *hamuli*.

In the males of many species the wings bear scent glands. Sometimes these are merely scattered, associated with special scales, the *androconia*, which are designed to spread the scent, (as in Pieris and Eurymus). Frequently there are structures developed for their protection; as, for instance, the pocket on **Cu** in Danaus, on the inner margin in Carsia, the folded inner margin of many Olethreutes (fig. 266), of Lobophora and Heterophleps, and so on. The costal edge is particularly apt to be folded over, forming the *costal fold* (fig. 265, 306), and this may contain a large tuft or mass of androconia, as in a large part of our Hesperiinæ and Tortricidæ. In some instances the secreting area is clothed with special scales, forming a *stigma* (fig. 249). This is usually easy to see, but in such forms as Cercyonis and a few Pamphilas it is easiest to moisten the wings with chloroform or benzine and hold the butterfly to the light. When not specially noted, the location of a stigma is the upper side of the fore wing below the cell, in the Satyrinæ and Hesperiidæ, or at the end of the cell as in Thecla.

[5] A somewhat similar lobe occurs on the hind wing of some male Geometridæ and Tortricidæ (fig. 267), but probably with the function of a scent organ.

Two other structures on the thorax are occasionally of importance in some species. The dorsal part of the prothorax may be extended in a pair of mushroom-shaped bodies, the *patagia,* or, taken together, the *collar.* Sometimes they are called tegulæ (fig. 16, **sct**$_1$). They are only conspicuous in the Noctuoidea, and even there are so buried in vestiture as to appear merely part of the general body surface. The true *tegulæ* (sometimes called patagia) are attached at the base of the fore wing and loop about it, covering the base of the costa and the whole articulation (fig. 16, **tg.**). The part of the mesothorax exposed between the tegulæ is the *disc.* The metathorax is narrow above, widening a little to support the wings, and bears the basal hair. The general surface of the thorax is divided into a considerable number of sclerites, as in other insects; but as they are little used in classification, the figure is sufficiently explanatory.

To study the surface it must be denuded of scales and hairs. The back of the insect, above the level of the wings, is the *dorsum* or *tergum,* and its sclerites are *tergites* (**sct**, **scl**); the sides from wings to legs, are *pleura,* composed of *pleurites* (**eps, epm,** etc.), and the lower side, between the legs, is the *venter,* made up of *sternites* (**s**).

The abdomen is normally composed of ten segments, several of which are usually concealed, and it bears at its end the sexual organs, the most conspicuous of which, in the male, are the *valves,* a pair of claspers for holding the female; and, in the female, the *ovipositor,* or instrument for placing the eggs.

The abdomen may be divided like the thorax into dorsum, pleura, and venter, though in the absence of legs and wings the boundaries may seem a bit arbitrary. The membrane on the sides is considered to represent the pleura. On the first segment there is however a deep groove, the *tergo-pleural groove* (fig. 16, **tpl.**), and a small pleurite below it. Scent-tufts occur on the abdomen in many males, especially near the base in the Noctuidæ and near the apex in the Geometridæ. They are usually retractile in pockets when not in use, and are rarely seen expanded. Those near the tip of the abdomen (on the seventh segment) are called *coremata.*

In the males of most species there are eight visible segments. The body of the ninth (fig. 20) is reduced to a ring, the tergite of which is the *tegumen,* and its sternite the *saccus* or *vinculum.* Attached to the junction of tegumen and saccus is the *valve* (harpé), the name of which indicates a common form. The valve may be composed of a thickened dorsal edge, or *costa,* a central part, the *valvula,* or valve proper, and a lower part which is strongly curved and spoon-like, the sacculus. Lying in the middle line between the valves is the penis, or

ædœagus, which is retractile, and often works through a ring, the *juxta.* Its reversible lining is often armed with spines, known as *cornuti.* The *furca,* a curious fork or simple spine in some Ennomids, is formed from the lower part of the juxta and may resemble an additional ventral valve. Its two halves are often separate. Besides these parts there is a great variety of secondary structures, of which the most important are the *clasper,* a hook developed on the inner face of the valve, and the *peniculus,* a hairy prominence arising from the edge of the tegumen above the valve.

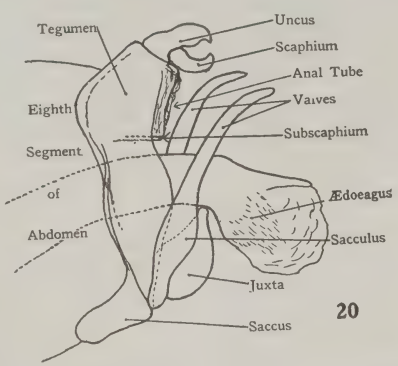
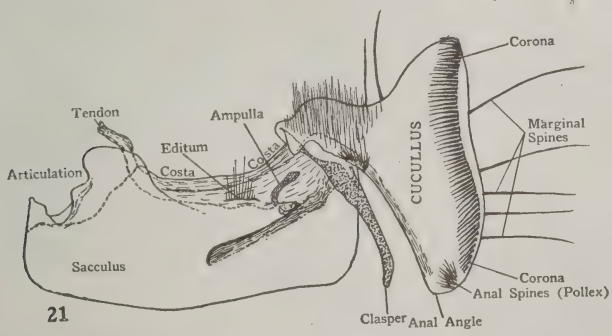


FIG. 20. TYPICAL MALE GENITALIA, SIDE VIEW (EUBAPHE OSTENTA)

The end of the valve, especially in the Noctuidæ, often bears a row or mass of recurved spines, the *corona* (fig. 21). A finger-like process on the dorsal edge of the valve is a *digitus,* one on the ventral edge a *pollex,* and one near the base on the inner face (generally hairy) is the *editum* (dorsally) or *clavus* (attached to the sacculus). When the clasper is divided, as in Acronycta, its dorsal arm is the *ampulla.*

The tenth segment is further reduced. Its dorsal part is the *uncus,* which is most often a strong hook, but may be divided or reduced to



to see without dissection.

FIG. 21. VALVE OF MALE GENITALIA (HADENA DEVASTATRIX)

a plate, which in some forms is indistinguishably fused with the tegumen or scaphium; on each side it frequently bears a small appendage,

the *socius,* which is conspicuous in the Thyatiridæ and the Hemitheinæ. The ventral part of the segment, when it appears at all, forms a plate between the anal tube and the penis, known as the *transatilla,* in many cases articulated with the base of the valves.

The end of the intestine is commonly a long tube, in many species strengthened by the *scaphium* above and the *subscaphium* below. Whether these structures represent the eleventh segment is an open question. They may be simple bands or plates, or they may bear spines or be of striking forms. The *gnathos* is a partially free subscaphium articulating directly with the uncus.

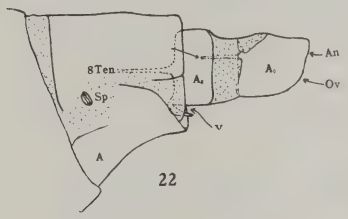


FIG. 22. TYPICAL FEMALE GENITALIA (LEUCANIA PALLENS).

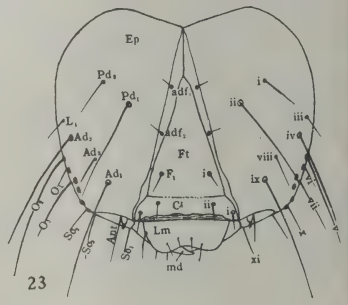


FIG. 23. HEAD OF LARVA WITH SETÆ NUMBERED BY DYAR'S SYSTEM (RIGHT) AND HEINRICH'S SYSTEM (LEFT)

Ad_1, **Ad_2**, **Ad_3**, Anterodorsal setæ of epicranium; **adf_1**, **adf_2**, adfrontal setæ; **Ant**, antenna; **Cl**, clypeus; **Ep**, epicranium; **Ft**, front; **F_1**, its seta; **L_1**, lateral seta of epicranium; **Lm**, labrum; **md**, mandible; **O_1**, **O_2**, **O_3**, ocellar setæ of epicranium; **Pd_1**, **Pd_2**, posterodorsal setæ of epicranium; **So_1**, **So_2**, **So_3**, subocellar setæ of epicranium

In most females the abdomen has seven visible segments (fig. 22). The eighth and ninth segments are retracted within the seventh and are, for the major part, composed of membrane. On the ventral surface of the eighth segment is the *vagina,* with a chitinous plate below it. The remainder of the segment is, in most cases, a short cylinder. The ninth segment is divided into two lobes between which lie the *anus* and the opening of the *oviduct.* The usual condition is shown in figure 22.

The four most primitive families show a different structure. In the case of the Micropterygidæ there are eight fully developed segments, and the ninth and tenth are invaginated within the eighth, the tenth segment being fairly well developed (fig. 34). The Eriocraniidæ and the Incurvariidæ have a complex piercing ovipositor, whose struc-

ture is shown in the figure of Eriocrania (fig. 38). The Hepialidæ have nine segments, but the structure is complex and not fully understood.

Larva

The caterpillars show the same essential structures and appendages as do the imagoes, but they are very different in development. As a rule, only the head is chitinized, the skin of the body being thin and flexible. The major part of the head (fig. 23) is composed of a pair of sclerites, the *epicrania.* Between these, on the face, lies the *front,* which is in most instances triangular and rarely reaches the top of the head. Between the front and epicrania there are two very narrow sclerites, the *adfrontals,* in some works called the *paraclypeals.* Below the front is a third narrow sclerite, the *clypeus.* The lower half of this, more or less, is composed of membrane. On the under side of the head there are two small triangular sclerites, the *postgenæ.*

The *antennæ* are very short and small, and lie immediately above the *mandibles,* which are the principal structures associated with the mouth. In front of the mandibles there is a flap, the *labrum* (fig. 24), which serves as an upper lip. Behind the mandibles there is a second, somewhat thicker flap which functions as a lower lip. It is composed of the fused *maxillæ* and *labium.* It is complex in structure and but little used in classification. The *eyes* are represented by six small, separate *ommatidia,* located in a group low down on the side of the head, as shown in figure 232. There are a considerable number of *setæ* which are constant in number and position in any given species. A typical arrangement of these is shown in figure 23. There are two methods of designating the setæ. The right side of the figure is labeled according to the method most often used in the past, while the left side bears the system recently proposed by Heinrich.

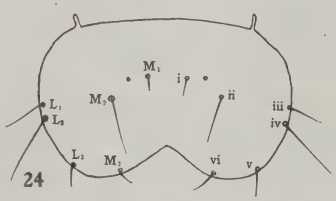


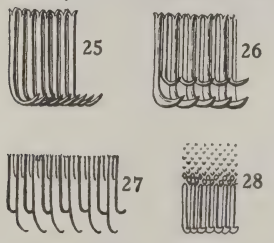
FIG. 24. LABRUM, THE SETÆ NUMBERED ACCORDING TO FORBES'S SYSTEM (RIGHT) AND HEINRICH'S SYSTEM (LEFT)

L_1, L_2, L_3, lateral setæ; M_1, M_2, M_3, median setæ

The body is composed of thirteen distinct segments, three belonging to the thorax, and ten to the abdomen. The ninth segment of the abdomen is, in most cases, much smaller than the others. The prothorax bears a sclerite on its dorsal surface known as the *cervical shield* (shown in the diagrams at the head of each family). The setæ on the side are arranged in two groups, called the *prespiracular,* and the *subventral, warts.* Each of the segments of the thorax bears a small leg

which shows the usual segments, coxa, femur, tibia, and tarsus; but all are very small, and the tarsus is composed of a single segment and ends in a single claw. The abdomen is without true legs, but the third to sixth and last segments bear membranous *prolegs,* which may have, at the tip, a series of hooks, or *crotchets.* There are *spiracles* on the side of the first segment of the thorax and the first eight of the abdomen. In many caterpillars, especially aquatic forms, the last spiracle lies on the dorsum and faces backward, as shown in the figure of Carposina (fig. 293). The body, as a rule, bears a regular arrangement of setæ on each segment. These setæ are designated by numbers, as shown in the figures, and are known as *primaries*; when there are a small number of additional setæ, they are known as *subprimaries* (figs. 434, 439); a large number, indefinite in position, are called *secondaries* (fig. 405). In certain families, in place of single setæ in the primary positions, the tubercles from which the hairs arise are grouped in *warts,* each bearing a tuft of setæ (fig. 406). In this case the caterpillar is spoken of as having tufted hair.

The hooks on the prolegs also show a definite arrangement (figs. 25 to 28). If those of a series are all of the same length, or regularly graded in length, they are called *uniordinal;* when alternately of two lengths, *biordinal;* and when of three lengths, *triordinal.* If there are one or more rows of rudimentary hooks at the base of the functional ones, the arrangement is called *multiserial.* The series of hooks may be arranged either in one or two transverse bands, a longitudinal band, or an ellipse which is usually broken at one or two points. In very rare cases, when there is a longitudinal band on the inner face of the proleg, there is a weaker band, or some scattered hooks, on the outer face. Fracker calls this arrangement a *pseudocircle.*



FIGS. 25–28. HOOKS OF PROLEGS, TYPICAL ARRANGEMENTS

25, uniordinal, uniserial; **26**, biordinal; **27**, triordinal; **28**, multiserial

Pupa

The pupa, or chrysalis (fig. 29), also shows all the structures characteristic of an insect. All the appendages, however, are folded back on the body and may be soldered to it. The most conspicuous appendages are the *wings,* which lie on either side of the venter, at the front end of the body. The hind wings are almost completely covered by the fore wings, but a small portion of their posterior edges may show. On the midventral line lies the *tongue,* and between the tongue and the

wings are the first two pairs of *legs* and the *antennæ*. The *mesothorax* and *metathorax* are easily recognized by their attachment to the wings. The *prothorax* lies immediately in front of them, and the remainder of the front of the body belongs to the head. In many species this is divided, by transverse sutures, into two or three sclerites. The mouth is surrounded by the *labrum* in front and the tongue behind. On the sides the *mandibles* are located when they are developed, but they are absent in most species. In the more primitive forms the *maxillary palpi* (or "eye-collar") appear immediately behind the eyes as small oblong or triangular sclerites. The abdomen is composed of a regular series of segments, the first three or four of which are, in most cases, immovably soldered together. Then there come one or more movable incisures, and the terminal segments are again fused. An *incomplete* pupa is one in which there are four or more movable incisures, one more in the male than in the female, and in which the body is provided with spines to enable the pupa to work out of its burrow or cocoon or out of the soil. In an *obtect* pupa there are three or less movable incisures in both sexes, and the pupa does not leave the cocoon. At the end of the body there may be an extension bearing a tuft or group of setæ, which are hooked in most instances. This is the *cremaster*. In some pupæ the male may be distinguished by its wider antennæ, and in some the two separate reproductive openings of the female can be recognized.

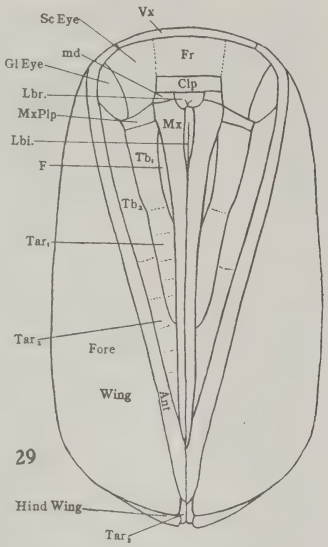


FIG. 29. VENTRAL VIEW OF ANTERIOR PART OF PUPA, DIAGRAMATIC, SHOWING STRUCTURES

Ant, antenna; **Clp**, clypeus; **F**, fore femur; **Fr**, front; **Gl Eye**, glazed eye; **Lbi**, labium, with **palpi**; **Lbr**, labrum, with pilifers; **md**, mandible; **Mx**, maxilla; **Mx Plp**, maxillary palpus (eye-collar); **Sc Eye**, sculptured portion of eye; **Tar_1**, fore tarsus; **Tar_2**, mid-tarsus; **Tar_3**, tip of hind tarsus; **Tb_1**, fore tibia; **Tb_2**, mid-tibia; **Vx**, vertex

SYNOPSIS OF THE FAMILIES OF LEPIDOPTERA

Suborder **Jugatæ.** Moths with fore and hind wings similar in form and venation, and with at least four radials in the hind wing. Base of cubitus fused with **1st A,** a short portion of it appearing like a cross vein between **1st A** and the apparent base, which is in fact the arculus. Wing membrane spinulated (fig. 30). Frenulum rudimentary or absent. Fore wing with a separate lobe, or jugum, at base of inner margin. Larvæ with dorsal setæ similarly arranged on thorax and abdomen.

Family 1. **Micropterygidæ.** Minute moths, with functional mandibles, and maxillæ of primitive type formed of galea, lacinia, and palpus; feeding on pollen. Fore wing with subcosta forked near its middle. Female with ten abdominal segments preserved and without ovipositor. Larvæ with modified clubbed setæ, feeding on wet moss. Pupæ with large mandibles.

Family 2. **Eriocraniidæ.** Minute moths, with rudimentary mandibles, and maxillæ possessing a short coiled tongue. Lacinia absent. Subcosta of fore wing forking near its apex. Female with complex piercing ovipositor, laying its eggs in the tissue of leaves. Larvæ without hooks on the prolegs, which are rudimentary; with simple setæ, mining in leaves. Pupæ with large mandibles.

Family 3. **Hepialidæ.** Large, or very large, moths, with rudimentary, nonfunctional mouth parts, save for the labial palpi. Subcosta of the fore wing forking near its middle or simple. Female without piercing ovipositor. Larvæ of normal caterpillar form, boring in stems and roots; with a circle of hooks on the prolegs. Pupæ with small obscure mandibles, and rudimentary, divergent maxillæ.

Suborder **Frenatæ.** Moths with hind wing much smaller, or shorter and broader, than fore wing, with at most two free branches of radius. Cubitus straight to base, no portion of it appearing like a crossvein. Wing membrane rarely spinulated. No jugum. Hind wing usually with a frenulum. Antennæ rarely clubbed, and clubbed in none of our forms which lack a frenulum. Pupa with trachea $\mathbf{R}_{4+5}$ arising from the stem of radius beyond that of $\mathbf{R}_1$. Larvæ almost never with dorsal setæ similarly arranged on thorax and abdomen.

**Wings with aculeæ over the general surface.*

Superfamily **Incurvarioidea.** Venation fairly complete; antennæ without eye-cap; female with piercing ovipositor (so far as known): larvæ usually case-bearers when mature.

Family 4. **Incurvariidæ.** Characters of the superfamily.

Superfamily **Nepticuloidea.** Venation much reduced; cell very small or absent; antenna with large eye-cap; female without ovipositor,

the eggs laid exposed. Larvæ leaf-miners or bast-miners when mature.

Family 5. **Nepticulidæ.** Characters of the superfamily.

***Aculeæ confined to small areas or absent.*

†*Larvæ with warts* **i** *and* **ii, iv** *and* **v** *united.*

Superfamily **Zygænoidea.** Moth with primitive venation, large wings, and minute maxillary palpi or none; **Sc** and **R** of hind wing usually uniting along cell. Larvæ short and slug-like; typically with diffuse hair-tufts; pupa primitive, incomplete, with all segments free; first abdominal spiracle uncovered, maxillæ usually extended and toothed laterally, but without maxillary palpus.

Family 6. **Megalopygidæ.** Moths with tongue obsolete; wings heavily and loosely clothed with soft scales, often mixed with curly hair; hind wings with **Sc** and **R** fused for most of length of cell. Larvæ with 14 prolegs, 10 of them with an angulate or broken band of hooks.

Family 7. **Eucleidæ.** Moths with tongue obsolete; wings usually heavy and loosely scaled; hind wings with **Sc** and **R** shortly fused near base. Larvæ with prolegs absent, replaced by a system of sucking discs; hairy, spiny, or naked.

Family 8. **Pyromorphidæ.** Moths with tongue strongly developed. Wings translucent; hind wings with **Sc** and **R** fused toward outer end of cell, the basal part of **R** also fused with **Sc** or obsolete. Larvæ with tufted hair; with 10 prolegs, provided with normal hooks.

††*Larvæ with warts* **i** *and* **ii** *separate,* **iv** *and* **v** *often united.*

‡*"Micros." Larvæ with three setæ on prespiracular wart, usually concealed feeders; moths with soft-scaled wings with broad fringes, broadest at anal angle, the wings often lanceolate or linear;* $\mathbf{R}_5$ *often running to costa or apex; accessory cell, when distinct, with its broad side resting on discal cell, often fusing with it; hind wing with* **Sc** *and* **R** *never fusing beyond cell, and very rarely at any point, the base of* **R** *often obsolete;* **1st A** *rarely lost unless wing is very narrow; tongue very often scaled at base.*

Superfamily **Tineoidea.** Larvæ with setæ **iv** and **v** separate; pupa normally incomplete; moth normally with rough head, often with folded maxillary palpi; tongue scaled when present; fore wing usually with $\mathbf{R}_5$ running to costa, hind wing with **R** and $\mathbf{M}_1$ separate, **Sc** and **R** typically approximate at base.

Family 9. **Tineidæ.** Larvæ with anal prolegs unlike the ventrals; most often scavengers; moths winged in both sexes, without a heavy anal tuft in the female; usually with rough head, folded maxillary palpi, and bristles on the labial palpi, or with the first joint of the labial palpi enlarged.

Family 10. **Psychidæ.** Larvæ with anal prolegs similar to the ventrals, each with a single ellipse of hooks, broken on inner side; always living in a case. Female moth with a tuft of heavy hair-scales at the end of the abdomen, which

are mixed with the eggs; almost always wingless, and often maggot-like with all appendages rudimentary. Male with rudimentary mouth parts.

Family 11. **Tischeriidæ.** Larvæ leaf-miners; the thoracic legs absent, and each ventral proleg with two transverse rows of hooks. Moths with a loose tuft of scales on vertex, a small scape, short porrect palpi without bristles, small maxillary palpi, and very hairy hind tibiæ; fore wing with Cu running through the center of the wing, with all radials running to costa.

Family 12. **Lyonetiidæ.** Larvæ leaf-miners; structurally much like the Tineidæ, flattened, with setæ iv and v more widely separated. Moths with head smooth, at least on front, with a well-marked eye-cap, the hind wing with R running through the axis of the wing, which is often linear.

Family 13. **Opostegidæ.** Larvæ very slender, cylindrical, without legs; bast-miners; moths with folded maxillary palpi; with very large eye-caps; fore wing with three or four unbranched veins, hind wing linear. (Position of family uncertain.)

Family 14. **Gracilariidæ.** Larvæ when young very much flattened, with blade-like mandibles, and rudimentary maxillæ and labium; living as leaf-miners and bast-miners and eating the sap only; when grown usually with normal mouth-parts, eating the parenchyma, and often living as leaf rollers. No prolegs on sixth segment of abdomen; the other legs variable. Moth with maxillary palpi porrect or obsolete, our species without eye-cap; fore wing lanceolate, normal or with somewhat reduced venation; hind wing often linear, with principal vein through the center of the wing; sometimes with R_1 free. (Position of family uncertain.)

Family 15. **Coleophoridæ.** Larvæ with iv and v closer than usual; with very strong true legs, and prolegs reduced, each with two transverse bands of hooks or none; usually leaf-miners when young, or feeding within seeds; almost always becoming case-bearers when grown. Moths with smooth head; palpi moderate, usually tufted, with the third joint often set on at an angle; fore wing with cell set obliquely, the cubitals extremely short and running directly to inner margin. Epiphysis rudimentary, at apex of fore tibia, or absent. Antennæ turned forward in repose. (Position of family uncertain.)

Superfamily **Cycnodioidea.** Larvæ and pupæ not well known; apparently the larvæ with setæ iv and v close together; leaf-miners when young and case-bearers when grown. Pupæ without maxillary palpi, with nearly all segments of abdomen free, or, in Elachista, which pupates exposed, with all soldered. Moth with R_{2+3} of hind wing preserved, running to costa, maxillary palpi minute and straight or lost, and with characteristic genitalia; R_5 running to costa, lost in all our species; Sc and R of hind wing widely separated, in our species with R running through middle of wing.

Family 16. **Cycnodiidæ.** Palpi moderate, upturned; hind wing lanceolate, with well-formed cell, and nearly complete venation. Larva sixteen-legged, a blotch-miner; pupa suspended, exposed, immobile.

Family 17. **Douglasiidæ.** Palpi short, drooping; ocelli very large; hind wing without cell; with R_{2+3} separating off from radial stem before M_1. Larvæ leaf-miners, hardly known. (Position of family uncertain.)

Family 18. **Heliozelidæ.** Palpi short, drooping; hind wing without cell; one or two medials arising from R-stem, which forks into R_{2+3} and R_{4+5} near apex. Larvæ legless, with two pairs of ocelli; blotch-miners; cutting out a case just before pupation.

Superfamily **Gelechioidea.** Larva with setæ iv and v closely approximated or on the same tubercle, usually with developed prolegs; pupa obtect, maxillary palpi usually present, but pilifers not marked, and front femora and labial palpi usually connected. Moth with all radial branches running to costa as a rule, and usually all present; R_4 and R_5 stalked except in Stenominæ. Hind wing with **Sc** and **R** closely approximate at base, separating before end of cell (shortly fused in Blastobasidæ). Head more or less smooth; palpi long and upturned, maxillary palpi minute, folded over base of tongue, which is scaled.

Family 19. **Œcophoridæ.** Fore wing without stigma; R_2 and Cu_2 well back from end of cell; hind wing at least half as broad as fore wing, with apex of membrane bluntly rounded; **R** and M_1 well separated at origin; **1st A** preserved in both wings.

Family 20. **Xylorictidæ.** Fore wing without stigma; R_2 and Cu_2 well back from end of cell, R_4 and R_5 often separate, when stalked forking over apex; hind wing broad, not excavated below apex, with **R** and M_1 stalked.

Family 21. **Gelechiidæ.** Fore wing without stigma, R_2 and Cu_2 well back from end of cell, R_4 and R_5 stalked or united, and both running to costa; hind wing with **R** and M_1 closely approximated or stalked, or with wing strongly excavated below apex; **1st A** lost in both wings.

Family 22. **Blastobasidæ.** Fore wing with a stigma between R_1 and R_2, which are widely separated, veins R_2 to Cu_2 all closely crowded around end of cell. Hind wing with **Sc** and **R** very shortly fused near base; lanceolate, and rather narrower than fore wing; **R** and M_1 well separated at origin.

Family 23. **Lavernidæ.** Fore wing without stigma, lanceolate, with **1st A** variable, sometimes anastomosing with **2d A.** Hind wing much narrower than fore wing, narrow-lanceolate to linear, pointed, with **R** and M_1 strongly approximate at origin, or stalked, and M_3 and Cu_1 usually widely separated.

Superfamily **Yponomeutoidea.** Larva with setæ iv and v variable, pupa obtect in forms with iv and v separate, with maxillary palpi; normally with labial palpi and femora exposed; pilifer not marked. Moth with R_5 when present usually running to outer margin; maxillary palpi usually small or minute, and porrect; hind wing with **R** and M_1 variable, **Sc** and **R** approximate at base, and usually connected by a cross vein. Head usually smooth.

Family 24. **Yponomeutidæ.** Ocelli small or absent; legs typically smooth-scaled, venation but little reduced: fore wing usually with all veins separate; hind wing with **R** and M_1 well separated except in the Cerostoma group, M_1 and M_2 often stalked, **1st A** distinct in both wings. Egg of flat type so far as known. Larvæ with beta lower than alpha on prothorax, prespiracular wart of three setæ and iv and v widely separate on abdomen. Pupa obtect, with maxillary palpi exposed, pilifers represented by distinct lobes only in Atteva, and fore femora exposed except in Scythris. (To this family are attached various isolated genera of uncertain position.)

Family 25. **Glyphipterygidæ.** Ocelli large and conspicuous, maxillary palpi minute, tongue scaled, labial palpi upturned to middle of front or beyond, often beyond vertex; wings exceptionally broad, macro-like in shape, the fringe relatively narrow, and but little widened at anal angle. R_4 and R_5 usually separate,

Cu_2 arising close to angle of cell; **R** and **M_1** usually separate in hind wing; **2d A** very strongly forked at base. Egg of upright type; larva with front acute, reaching well toward, but not to, vertex; **alpha** of prothorax farther from mid-dorsal line than **beta,** abdomen with **i** nearer the middle line than **ii** on eighth segment, **iv** and **v** close together, legs with a single circle of hooks. Pupa incomplete, with only anterior rows of fine spines on the segments, cremaster rudimentary; maxillary palpi, labial palpi and fore femora exposed; mesothorax extending back in a lobe, nearly cutting the metathorax in two.

Family 26. **Heliodinidæ.** Palpi very short, drooping (medium sized in Euclemensia); maxillary palpi minute, porrect; tongue strong; tarsi with more or less distinct whorls of bristles, the tibiæ also often with stiff bristles, the hind legs displayed at rest. Larvæ various, not well known, pupæ hardly known.

Family 27. **Ægeriidæ.** Antennæ often fusiform, normally with a tuft of bristles at apex; wings strong, very narrow, usually more or less transparent. Fore wing with **R_5** running to outer margin, anal region much reduced, hind wing with costa bearing a backward-directed keel, with a row of spines interlocking with a row on inner margin of fore wing. Larvæ borers, with high front, hooks of prolegs uniordinal in two transverse rows, **iv** and **v** close together, and last spiracle higher than the others; pupa incomplete.

Superfamily **Tortricoidea.** Larva with setæ **iv** and **v** approximate, pupa incomplete, typical, spined dorsally for progression; moth normally with **R_5** running to outer margin, free in lower forms; stalked with **R_4** in higher forms, hind wing with **Sc** and **R** as in the preceding superfamily, **R** and **M_1** usually approximate; head and body usually with rough vestiture, that on the head shorter than in the Tineidæ; palpi rough and more or less triangular or porrect; maxillary palpi minute.

Family 28. **Tortricidæ.** Fore wing with **1st A** preserved, **Cu_2** arising less than three-fourths way out on cell; larva with biordinal or triordinal hooks; abdomen of pupa with a distinct cremaster, or with setæ on the anal rise.

Family 29. **Phaloniidæ.** Both wings without **1st A; Cu_2** arising more than three-fourths way out in cell; hind wing with **M_1** preserved, usually stalked with **R;** palpi alike in both sexes. Larva with uniordinal hooks; pupa with end of abdomen obliquely truncate, with irregular spines, without cremaster.

Family 30. **Carposinidæ.** Both wings without **1st A; Cu_2** arising more than three-fourths way out; hind wing with **M_1** and **M_3** completely lost; palpi much longer in female than in male. Larva a fruit borer with a complete circle of uniordinal hooks and last spiracles dorsal.

Family 31. **Cossidæ.** Large, stout, heavy moths, with small palpi, rudimentary tongue, partly hairy vestiture, and short tibial spurs. Wing veins heavy, including **R_{4+5}** and the dividing veins in the cell, **1st A** strong and tubular, from near base. Frenulum sometimes obsolete. Egg sometimes upright; larva stout and strong, with mandibles heavy and turned forward, usually with multiordinal hooks in a complete circle; setæ **ii** as far apart on ninth abdominal as on other segments. Pupa very heavy, with extremely short maxillæ which meet on middle line; no maxillary palpi, and no cremaster.

‡‡*"Pyraloids." Larvæ with only two setæ on prespiracular wart, with* **iv** *and* **v** *approximated, rarely with secondary or tufted hair (in which case the spiracles are round); pupa*

obtect but almost always with distinct maxillary palpi; practically never progressing from the cocoon. Moth normally with firmly and finely scaled wings, with ample anal region in hind wing; usually with three anals in hind wing, but with **1st A** *almost always lost in fore wing; maxillary palpi of porrect type; tongue scaled at base; no accessory cell.*

Superfamily **Pyralidoidea.** Characters as just stated for the Pyraloids.

Family 32. **Thyrididæ.** Wings heavy and close-scaled, **1st A** absent in both wings, all radials separate (variously stalked in exotic species), R_5 to outer margin; hind wing with **Sc** and **R** closely parallel beyond end of cell; maxillary palpi obsolete, pilifers large. Larva with two setæ on **vii** of mesothorax, and **i** higher than **ii** on ninth abdominal segment.

Family 33. **Pyralididæ.** Wings entire, without special scaling along the veins beneath; fore wing with **1st A** usually lost. Hind wing with **Sc** and **R** very closely approximate, or more often fused, beyond end of cell. Larva with primary setæ only, with normal prolegs, usually bearing biordinal or triordinal hooks, pupa with seventh abdominal segment fixed in both sexes, usually smooth; with a deep furrow between ninth and tenth abdominal segments in the few species without maxillary palpi.

Family 34. **Pterophoridæ.** A series of specialized spatulate scales along **Cu** and its forks in hind wing; our species with fore wing divided into two, and hind wing into three, feathers; **1st A** preserved. Larva usually with secondary or tufted hair, with very long, stem-like prolegs with expanded plantæ. Pupa usually exposed, suspended by the tail, often very hairy and angular; seventh abdominal segment movable in male; without maxillary palpi or groove between ninth and tenth abdominal segments. Cremaster supplemented by a second tuft of spines on venter.

Family 35. **Orneodidæ.** Both wings deeply cleft into six feathers. Only one anal preserved (**1st A**?). Larva with uniordinal hooks on prolegs and a single seta **vii** on mesothorax. Pupa with maxillary palpi concealed; seventh segment fixed. Cremaster simple.

‡‡‡*"Macros." Larvæ with only two setæ on prespiracular wart, with* **iv** *and* **v** *separate except when there is dense secondary hair; with oval spiracles, and often with dense tufted or secondary hair. Usually external feeders. Pupa obtect, progressing only in the* Citheroniidæ, *without distinct maxillary palpi or pilifers; moth broad-winged, with* **1st A** *rudimentary or absent in all wings, base of* **M** *lost, maxillary palpi of porrect type and almost always rudimentary or lost, tongue not scaled; wings usually firmly scaled, with narrow fringes; accessory cell when present separated by a fully developed vein from discal.*

Superfamily **Uranioidea.** Larva with simple hair; setæ **i** and **ii** separate, **iv** and **v** both well below spiracle, and tending to approximate

each other; hooks on prolegs biordinal, in an elliptical band; one or more additional setæ on prolegs. Pupæ hardly known. Egg of flat type. Moth with a slight chitinization subventrally on first segment of abdomen, representing tympanum; fore wing typically with R_5 and M_1 approximate or stalked, in Lacosomidæ with R_4 and R_5 stalked and widely separated from R_3; Cu apparently three-branched (trifid). Hind wing with Sc and R sharply diverging from close to base of wing.

Family 36. **Epiplemidæ.** Larva living practically exposed; with circle of hooks on prolegs broadly interrupted; moth with R_5 stalked with M_1, free from R_4; moth resting with hind wings rolled about body. Frenulum normal in our species.

Family 37. **Lacosomidæ.** Larva with hooks of prolegs in a complete ellipse; living in a case, open at both ends; thin-skinned, with chitinized thorax and posterior callosity. Moth with R_4 and R_5 widely separated from R_3; frenulum rudimentary in our species; resting position normal. (Position of family doubtful.)

Superfamily **Saturnioidea.** Larva always with fine, usually rudimentary secondary hair; primaries on warts or spines which also bear secondary setæ; iv and v united, i of eighth segment of abdomen usually united in middle line; prolegs with a straight band of biordinal hooks. Egg of flat type. Moth without tympanum, the metathorax not modified; tongue rudimentary in our species; fore wing always with trifid venation; M_2 closely associated with radial stem, one radial always lost (R_5 ?), R_2–R_4 stalked and much crowded; hind wing as in the family Lacosomidæ; frenulum lost.

Family 38. **Citheroniidæ.** First-stage larva usually with primary hair; ninth segment with a mid-dorsal spine, anal plate tuberculate or spined; body spines more or less horn-like, never with long spinules, and strongly unequal in our species. Pupa formed in the ground, active, hard and rough, with flanged segments. Cremaster bifurcate, without hooks. Moth with male antennæ doubly bipectinate halfway to apex; fore wing with M_1 more or less stalked with R_2–R_4 parallel to M_2; hind wing with two anals.

Family 39. **Saturniidæ.** Larva with dense bristly spines in earlier stages, never with primitive first stage; warts i of eighth segment of abdomen fused into a caudal horn in all our species, ii rarely fused, ii of ninth segment fused only in the Hemileucinæ, which have subequal bristly spines and a smooth anal plate. Pupa almost always in a cocoon, not spinulose; cremaster simple or represented by spines only; abdominal segments often without flanges, and telescoping when dried. Moth with antennæ plumose to apex in male, in all our species, M_1, in our species, free from R, typically closely associated with M_2; 3d A usually rudimentary.

Superfamily **Bombycoidea.** Larva always with much secondary hair, even on head; with warts, often obscured after first stage; with an additional subdorsal wart; legs as in the Saturnioidea; larva often tending to be flattened. Egg of flat type. Pupa normally with secondary hair, with visible labial palpi. Moth various, without

tympanum, ocelli, or maxillary palpi, with pectinate antennæ; tongue very rudimentary or lost. **Hind wing** with **Sc** and **R** closely parallel from base, diverging before end of cell; R_1 usually distinct.

Family Bombycidæ. Larva with rudimentary hair; with caudal horn. Moth with **Cu** apparently 3-branched; R_4 and R_5 stalked farthest; no humeral veins; and rudimentary frenulum. Traces of **1st A** preserved. (Cultivated only.)

Family 40. Eupterotidæ. Larva with fine dense hair, usually mixed with some spatulate scales, with dorsal hair-pencils. Pupa not hairy; in the ground. Moth with R_2 and R_3, R_4 and R_5 stalked; **Cu** apparently 3-branched, and frenulum in our species normal. No humeral veins nor traces of **1st A.**

Family 41. Lasiocampidæ. Larva with fine secondary hair, in some exotic species mixed with scales; without slender pencils. Pupa hairy; in a cocoon. Moth with apparently 4-branched cubitus; R_5 stalked with M_1, and R_2 with R_3; no trace of **1st A.** Hind wing with frenulum lost, with two or more humeral veins, and expanded humeral angle, which is exposed in the resting position.

Superfamily **Drepanoidea.** Larva with some subprimaries but without secondary hair; tubercle **iv** somewhat higher than **v** and well separated; prolegs with a band of biordinal hooks, and usually a few outer hooks also, uniordinal in Eudeilinea. Anal legs slightly weakened or absent. Egg flat; pupa thin-shelled, in a cocoon. Imago with tympanum formed of a large, double, subventral chitinization on abdomen, not opening to exterior unless through the pleural suture; thin-winged; **Cu** quadrified in the American species, at least in the hind wing; hind wing with **Sc** and **R** separate to beyond end of cell, then sometimes fusing.

Family 42. Thyatiridæ. Larva with all legs. **Cu** trifid in fore wing; vestiture deep, making the body appear stout. Frenulum knobbed at tip.

Family 43. Drepanidæ. Larva with anal prolegs lost (except in the Indian genus Euchera). Moth with **Cu** quadrifid in both wings, slender, often with hooked wings. Frenulum weak and normal or lost; humeral angle expanded.

Superfamily **Geometroidea.** Larva very rarely with secondary hair, but always with ventral subprimaries (at least one on sixth segment of abdomen), setæ **iv** and **v** remote, **iv** higher; prolegs with a band of biordinal hooks, often interrupted by a sucker. Egg of flat type except in Alsophila. Pupa normal without exposed maxillary palpi or labium. Imago with a large tympanic hood at base of abdomen, opening subventrally, below spiracle. No ocelli or maxillary palpi; wings usually thin, hind wing with **Sc** and **R** closely parallel or fused part of length of cell, separated at base and beyond cell, strongly curved or angled at base, usually sending a brace across to base of frenulum.

Family 44. Geometridæ. Characters of the superfamily; **Cu** trifid, except in Operophtera.

Superfamily **Sphingoidea.** Larva with many minute secondary hairs, obscuring the primaries, which are single; in first stage with seta **v** higher than **iv**; **i** of eighth segment of abdomen united on mid-dorsal line, usually on a horn. Egg of flat type, usually spherical. Imago heavy-bodied, with very strong wings; no tympanum; fore wing with **3d A** a strong tubular vein, running into **2d A**; hind wing with **Sc** and **R** closely parallel, connected by $\mathbf{R}_1$, which is as strong as the other veins. Abdomen almost always spined along posterior edge of segments.

Family 45. **Sphingidæ.** Characters of the superfamily.

Superfamily **Noctuoidea.** Larvæ with variable vestiture, often with tufted hair; seta (or wart) **iv** widely separated from **v**, higher, sometimes behind spiracle; hooks or prolegs *uniordinal* in a single band. Egg *upright*. Imago with a stretched membrane in metepimeron which is more or less broken up into several sclerites; hood on base of abdomen, either above level of spiracle or enclosing it, occasionally lost; ocelli often present; maxillary palpi present and scaled, but almost always minute; **3d A** of fore wing weak, hind wing with **Sc** and **R** never divergent from base, rarely connected by a brace-vein to frenulum, never closer together beyond cell than along cell, usually fused for part of length of cell or connected by a cross vein. **Cu** quadrifid, except in the Notodontidæ, and the western family Dioptidæ, which also always lack the hood.

Family 46. **Notodontidæ.** **Cu** trifid; **Sc** and **R** of hind wing independent, or connected by a weak cross vein; larva with anal prolegs more or less reduced or modified; almost invariably raised in resting position.

Family 47. **Liparidæ.** **Cu** quadrifid, as in the following families; palpi short; tongue rudimentary, ocelli absent; antennæ plumose in male; hood above spiracle. **Sc** and **R** of hind wing connected by a cross vein, or touching at a point, more than a third way out on cell. Larva with tufted hair, with two bright-colored dorsal glands on abdomen.

Family 48. **Noctuidæ.** Palpi various; tongue normally functional; ocelli present (except in Menopsimus), hood usually enclosing spiracle, less often above spiracle or obsolete. **Sc** and **R** of hind wing touching at a point, less than a third way out on cell, or shortly fused; larva with either simple or tufted hair; in the latter case with secondary hair also, or with wart **iv** much lower on seventh abdominal segment than the others, and often obsolete.

Family 49. **Agaristidæ.** Like the Noctuidæ; antennæ clubbed, hood absent.

Family 50. **Arctiidæ.** Tongue often weak; ocelli always present; **Sc** and **R** fusing for at least a fifth, usually a half of length of cell, but not beyond end of cell; hood above spiracle. Larva with tufted and without secondary hair, the tufts rarely lost in last stage; wart **iv** of seventh abdominal segment not lower than on others. Two subdorsal warts on mesothorax and metathorax.

Family 51. **Lithosiidæ.** Similar to the family Arctiidæ, with the ocelli lost; wings smooth-scaled; hood sometimes lost. Larvæ usually with tufted hair much reduced in last stage; but present, at least when young; when well developed

in last stage, with the subdorsal warts of mesothorax and metathorax longitudinally placed.

Family 52. **Nolidæ.** Ocelli lost; tongue present, weak; fore wings tufted; hind wings with **Sc** and **R** fused more than half of length of cell; hood above spiracle. Larva with only 14 legs, with tufted hair; wart **iv** obsolete.

Family 53. **Euchromiidæ.** Ocelli present; tongue strong; palpi strong; hind wings with free part of **Sc** lost, the first developed vein being **R**. Hood very large, the abdomen constricted behind it in many exotic species. Diurnal. Larva with tufted hair, with only a single subdorsal wart on mesothorax and metathorax.

Suborder **Rhopalocera.** Butterflies with hind wing much shorter and broader than fore wing; with only a single free radial; fore wing with cubitus straight to base, sometimes with a rudiment of **1st A** arising from it near base; the rest of **1st A** lost. $\mathbf{R}_{4+5}$ of pupa given off from radial stem before the origin of $\mathbf{R}_1$, obsolete in imago but often with a trace showing as a short spur or a fold. No jugum or frenulum; humeral angle of hind wing enlarged, usually with a humeral vein. Antennæ more or less obviously clubbed, with the scaleless sensory area often covering the whole club, and rarely extending on the shaft (Feniseca). Tongue and labial palpi always strong; ocelli and maxillary palpi always absent. Egg upright, larva with tubercles **iv** and **v** well separated and both low in first stage, usually obscured in later stages; prolegs typically with triordinal hooks. Our butterflies are all diurnal, and all except Thanaos sleep with the wings raised over the body or outspread.

Superfamily **Hesperioidea.** (Skippers). Head very broad; front twice as wide as high; antennæ widely separated at base (two to four times their own width), usually with a strong but slender tuft of lashes in front of eye; fore legs with epiphysis, hind tibiæ usually with all spurs; fore wing with all veins present and arising separately from cell; hind wing with humeral vein usually running across from tip of basal thickening (costa) to bend in **Sc.** Larva with prothorax much smaller (in our species) than head or following segment; head capsule closed ventrally behind base of mouth parts by a small sclerite (gula); prolegs with a complete circle of hooks. Larva always a concealed feeder. Pupa rounded, suspended by a Y-shaped girth in a more or less perfect cocoon; with maxillæ extending out at base to reach eyes.

Family 54. **Hesperiidæ.** Frenulum and frenulum-hook absent.

Superfamily **Papilionoidea.** (True butterflies). Head narrower, the antennæ separated at their base by about their width or less; front less than twice as wide as high; eyes not lashed; fore legs without epiphysis (except in the Papilionidæ), hind legs with end-spurs only;

humeral vein, when present, extending free from **Sc** toward costa, often forked at tip, but not reaching edge of wing. Larva with prothorax not noticeably narrowed, without gula; prolegs with a single band of hooks, or if with a second outer band it is much reduced; suspension girdle of pupa a simple loop or absent; the tongue, in the pupa, not touching eyes.

Family 55. **Papilionidæ.** Fore leg with epiphysis; head broad; fore wing, in our species, with all radials; M_2 associated with Cu-stem (quadrifid), **3d A** free, turning down toward inner margin; hind wing with only one anal (in our species). Egg spherical. Larva very stout, with tufted hair in first stage; with osmeteria. Pupa girt, but loosely, the anterior end with two points.

Family 56. **Pieridæ.** Fore leg fully developed in both sexes, with claws and pulvillus, but without epiphysis, head narrower, but with the antennal sockets not encroaching on the eyes; fore wing with one or two radials lost in our species, except in Zegris, M_3 stalked with R-stem, M_2 associated with R-stem in both wings, **3d A** of fore wing rudimentary, running up into **2d A**; hard wing with two anals. Larva with fine secondary hair, slender and normal in form. Pupa girt loosely, angular, ending in a single spine.

Family 57. **Lycænidæ.** Fore leg nearly fully developed in male, with spinules on tarsus, but without normal terminal claws and pulvilli, wholly normal in female; head very narrow, the antennal sockets encroaching more or less on the eyes; front not depressed. Fore wing with one or two radials lost in our species, M_1 usually free; M_2 arising from the cross vein halfway between M_1 and M_3, often weak, the cross veins both weak. M_2 of hind wing as in fore wing; humeral lost in our species; anals as in the Pieridæ. Egg flat. Larva slug-like with retractile head, and fine secondary hair. Pupa short and rounded, closely girt.

Family 58. **Erycinidæ.** Fore leg quite reduced and brushlike in male; without claws or spines, with tibia expanded in a spine beyond articulation of tarsus; normal in female; head as in the Lycænidæ; venation as in the Lycænidæ, but with humeral vein preserved and our species with costa thickened out to humeral angle. Egg and larva and pupa of our species as in the Lycænidæ.

Family 59. **Nymphalidæ.** Fore leg reduced and nonfunctional in both sexes (except female of Libythea); head as in Pieridæ, front depressed; fore wing in our species with all radials, M_1 free, M_2 associated with R-stem in both wings; hind wing usually with humeral vein; anals as in the Pieridæ. Egg as high as wide, vertically ribbed; larva slender, with spines or fleshy filaments, or forked tail; rarely as in Pieridæ; pupa suspended by the tail only, or (in a few Satyrinæ) in a slight cocoon.

ARTIFICIAL KEY TO THE FAMILIES OF LEPIDOPTERA[6]

Imago

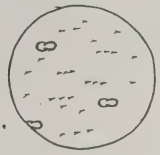


FIG. 30. PORTION OF WING MEMBRANE SHOWING SOCKETS OF SCALES AND WING SPINULES (ACULEÆ). HIGHLY MAGNIFIED

1. Winged 2
1. Wingless or with rudimentary wings 55
2. Hind wings with four or five radials, with at least ten veins besides anals (figs. 31, 40), wing-membrane spinulated (fig. 30) 3
2. Hind wings with only one free radial (two in the otherwise much reduced Douglasia group, page 224); with at most six (or, with Sc, seven) veins from cell 5
3. Wings hardly wider than their fringe, expanse about one-half inch 4
3. Wings ample, fringe narrow, expanse over one inch ..... Hepialidæ (p. 66)
4. Middle tibiæ with a spur; mouth parts formed for sucking; Sc of fore wing forking near apex ..... Eriocraniidæ (p. 64)
4. Middle tibiæ unarmed, mouth parts formed for biting; Sc forking near middle ..... Micropterygidæ (p. 62)
5. Each wing deeply cleft into six narrow strips ..... Orneodidæ (p. 652)
5. Fore wing moderately cleft into two, and hind wing deeply, into three, feathers (figs. 400–403) ..... Pterophoridæ (p. 639)
5. Wings entire, or one pair only, moderately cleft 6
6. Inner margin of fore wing and costal margin of hind wing with series of recurved spines and interlocking; fore wing at least four times as long as wide, and base, at least, of hind wing transparent (figs. 224–229) Ægeriidæ (p. 360)
6. Wings not interlocking at middle of margin, very rarely transparent, and, if so, with broader fore wings 7
7. Hind wing lanceolate, without marked anal angle, or notched below apex and trapezoidal, or cleft; the fringe almost as wide as wing, or wider. (Micros in part) 59
7. Hind wings much broader than their fringe, never lanceolate, and rarely trapezoidal with produced apex 8
8. A double series of enlarged and divergent scales along Cu of hind wing below; wings, body, and legs, very long ..... Pterophoridæ (Agdistinæ)
8. No such specialized scales 9
9. Fore wing with two anal veins well developed at middle of wing or at outer margin, the first a tubular vein at middle of wing in broad-winged forms, sometimes tubular only at the margin in narrow ones 10

[6] In the case of extra-limital families, no page is indicated; in those not included in this memoir, page references are made to the brief family definitions in the synopsis, pages 41 to 44.

9. Fore wing with only one anal reaching margin, **1st A** rudimentary, or represented by a fold; **3d A** at most by a short spur.....17
10. Antennæ strongly clubbed; **Sc** and **R** strongly divergent from close to base **Castniidæ**
10. Antennæ tapering regularly, or very slightly fusiform.....11
11. **Sc** separating from cell shortly before the apex of the cell (figs 62, 72).....16
11. **Sc** arising separate from **R**, running closely parallel to it to well beyond end of cell, or (in our species) fused with it beyond end of cell; the base of **R** in that case either complete or showing as a short spur (fig. 298) **Pyralididæ (Schœnobiinæ)** (p. 525)
11. **Sc** anastomosing with cell for short distance or not at all; not closely parallel to **R** beyond end of cell.....12
12. Accessory cell well marked.....13
12. Accessory cell absent.....14
13. Wings ample (fore wing not half longer than wide), body short and slender; mouth parts rudimentary .....**Dalceridæ**
13. Wings strong and lanceolate, body heavy, far exceeding hind wings, mouthparts rudimentary .....**Cossidæ** (p. 516)
13. Wings more or less oblong, usually twice as long as wide, and lightly veined; body small and slender; mouth parts usually developed, with scaled tongue .....**Micros** in part..59
14. Fore wing with **1st A** and **2d A** anastomosing or connected near middle of wing (fig. 101).....**Psychidæ** in part (page 140)
14. Fore wing with **1st A** and **2d A** independent beyond extreme base of wings..15
15. Fore wing with R_5 running to outer margin, base **M** distinct, running through center of cell; **Sc** and **R** of hind wing connected by a strong cross vein or anastomosing; tongue absent.....**Eucleidæ** (p. 102)
15. **Sc** and **R** of hind wing independent; or connected by a cross vein, when R_5 runs to costa (Ethmia); or anastomosing when base of media of fore wing runs near lower edge of cell or is completely lost (Tortricidæ); tongue usually present .....**Micros** in part..59
16. R_5 long-stalked (fig. 72), colors light, the northern species with crinkly hair on fore wing; tongue absent.....**Megalopygidæ** (p. 101)
16. R_5 from cell (fig. 61) dark, smoothly scaled forms; tongue present. **Pyromorphidæ** (p. 113)
17. Hind wing with three anals, the first often fading out toward base (fig. 19)..18
17. Hind wing with two anals or less; at most with a short spur of **1st A** at margin in broad-winged forms (figs. 409–432).....19
18. **Sc** and **R** of hind wing closely parallel or fused beyond end of cell (figs. 312–399 .....**Pyralididæ** in part (p. 523)
18. **Sc** and **R** strongly divergent from before end of cell.....**Micros** in part..59
19. Antennæ distinctly swollen toward tip, (figs. 5–7), and frenulum wanting (butterflies) 20
19. Antennæ not swollen toward tip, or if so (Agaristidæ, Sphingidæ, Coronidiinæ), wings with a strong frenulum.....25
20. Fore wing with all veins present, from cell, eyes strongly lashed in front; antennæ separated at base by a distance greater than half width of eyes .....**Hesperiidæ** (p. 43)
20. Fore wing with some radials stalked or absent; eyes rarely lashed; antennæ closer together 21
21. Fore wing with **3d A** free at tip, hind wing with only one anal, save in one Mexican species .....**Papilionidæ** (p. 44)
21. Hind wing with two well-developed anals; **3d A** of fore wing running into **2d A** or lost.....22
22. M_2 from middle of end of cell in both wings, or obsolete; fore wing, in northern species, with ten or eleven veins.....23

22. M_2 distinctly associated with radial stem, in one, and usually in both wings; lower discocellular vein often obsolete; with at least a trace of a humeral vein 24
23. A humeral vein in hind wing ..... **Erycinidæ** (p. 44)
23. No humeral vein ..... **Lycænidæ** (p. 44)
24. Butterfly walking on four legs (except female of Hypatus), radius five-branched; M_1 from cell ..... **Nymphalidæ** (p. 44)
24. Butterfly using all its legs for walking; radius usually four-branched, M_1 stalked with it ..... **Pieridæ** (p. 44)
25. North American species very stout, and with wings 55 mm. (two inches) or more in expanse; the hind wings rarely reaching beyond middle of abdomen; **Sc** and **R** of hind wing connected at the middle of the cell or rather before by a vein (R_1) which is as strong as any; and then closely parallel to end of cell or beyond ..... **Sphingidæ** (p. 42, 360)
25. Wings proportionately larger; **Sc** and **R** rarely connected by a strong cross vein, and if so, strongly divergent beyond it (fig. 426) 26
26. **Sc** and **R** separate, but connected by a more or less distinct cross vein; accessory cell fused with discal cell, but with the line of separation (R_{4+5}) indicated by a slight thickening starting from an angulation in the stem of **R**; species under 30 mm. in expanse (fig. 155) ..... A few **Micros**. . 59
26. Accessory cell separated by a full-sized vein, or completely absent 27
27. **Cu** of fore wing apparently three-branched (in a couple of Lithosians two-branched) 28
27. **Cu** of fore wing apparently four-branched 42
28. Frenulum normal 29
28. Frenulum rudimentary (less than one-fifteenth length of hind wings) or absent 35
29. **Sc** and **R** fused from base of hind wing beyond middle, then rapidly diverging; swollen at the base; slender moths ..... **Lithosiidæ** in part (p. 42)
29. **Sc** and **R** separate at extreme base; then closely approximate or fused a greater or less distance 30
29. **Sc** and **R** sharply divergent from close to base (fig. 409) . . **Epiplemidæ** (p. 654)
30. Hind wing with **Sc** angled near base, connected by a strong cross vein to humeral angle ..... Most **Geometridæ** (p. 41)
30. **Sc** of hind wing moderately curved or straight at base 31
31. Hind wing with **Cu** apparently 4-branched, M_2 being much nearer M_3 than M_1; **Sc** and **R** closely parallel beyond end of cell; vestiture deep (fig. 432). **Thyatiridæ** (p. 686)
31. Hind wing with **Cu** apparently 3-branched, M_2 being as near to M_1 as to M_3; **Sc** and **R** separating before end of cell (fig. 425) 32
32. Stout species; no tympanic hood; **1st A** lost 33
32. Usually slender species; when rather stout, with a well-marked lateral hood on first segment of abdomen 34
33. Tongue absent; fore wing with R_2 and R_3, R_4 and R_5 stalked together (fig. 425); northern species with hyaline dots on fore wing **Eupterotidæ (Apatelodes)** (p. 678)
33. Tongue present, often weak; fore wing fully scaled; usually with accessory cell, or R_3 and R_4 long-stalked together ..... **Notodontidæ** (p. 42, 678)
34. Subcosta straight to base and but little swollen; no trace of a tympanic hood. **Dioptidæ.**
34. Subcosta strongly sinuous and much swollen at base; a lateral hood at base of abdomen ..... A few **Geometridæ** (p. 41)
35. **Sc** and **R** of hind wing fused for a very short distance, then sharply divergent, separate from base, or connected by a weak cross vein (figs. 413–422); **tympanic hood absent** 36

35. Sc strongly divergent from R at extreme base, then sharply bent and touching, fusing or closely parallel to it, or connected by a strong cross vein; tympanic hood conspicuous, lateral.....A few **Geometridæ** (p. 41)
36. Antennæ naked, or with a few fugitive scales on shaft.....37
36. Antennæ closely scaled on upper side (figs. 9, 10).....38
37. M_1 stalked with R in both wings or neither; hind wing usually with one anal (figs. 413–416); male antennæ pectinate to apex.....**Saturniidæ** (p. 668)
37. M_1 stalked with R in fore wing but not in hind wing; hind wing with two anals (figs. 419, 422); male antennæ pectinate halfway to apex.
Citheroniidæ (p. 664)
38. Sc of hind wing sharply divergent from R from close to base (fig. 411).....39
38. Sc and R parallel at base, connected by a weak crossvein (fig. 426).....41
39. R_{4+5} widely separated from R_3 all the way from cell to margin (fig. 411).
Lacosomidæ (p. 656)
39. R_4 arising from cell closely associated with R_5.....40
40. R_5 and M_1 stalked or closely approximate at base, and separate from R_4 (like fig. 409).....**Uraniidæ**
40. R_5 separate from M_1 (like fig. 414).....**Lonomiidæ**
41. Frenulum about one-sixteenth length of hind wing; four radial veins in fore wing .....**Eupterotidæ (Eupterotinæ)**
41. Frenulum obsolescent, not exceeding humeral angle, or absent, 5 radials.
Bombycidæ (p. 679)
42. Cu_2 of fore wing arising from cell about a third way out from base, or even nearer base; R_5 stalked with M_1; with humeral veins and without frenulum in the North American species (fig. 427).....**Lasiocampidæ** (p. 679)
42. Cu_2 of fore wing arising well beyond middle of cell; hind wing usually with frenulum 43
43. Fore wing with complete venation (twelve veins) all the radials, medials, and cubitals arising separately, or with R_2 and R_3 shortly stalked (fig. 195).
Thyrididæ (p. 521)
43. R_3 and R_4, or R_4 and R_5 long-stalked, or with some veins absent.....44
44. Sc and R of hind wing parallel to beyond separation of R from cell, and then approaching very close or fusing a short distance (figs. 306, 435).....45
44. Sc fusing to upper side of cell or wholly independent.....46
45. First segment of abdomen with chitinized subventral bullæ, and a subdorsal cavity opening backward; northeastern species expanding over 25 mm.
Drepanidæ (p 688)
45. First segment of abdomen not modified; northeastern species expanding less than 20mm.....**Pyralididæ (Chrysauginæ)**[7] (p. 528)
46. Sc apparently absent, fused except at extreme base with R.
Euchromiidæ (p. 43)
46. Sc and R separating before end of cell.....47
47. Antennæ swollen toward tip.....**Agaristidæ** (p. 42)
47. Shaft of antennæ regularly tapering.....48
48. Ocelli present (fig. 3).....49
48. Ocelli absent 53
49. Sc and R of hind wing fused to middle of cell or beyond..**Most Arctiidæ** (p. 42)
49. Sc and R fused for more than a fifth length of cell, but the fusion not reaching middle 50
49. Sc and R fused for less than a fifth length of cell, the fusion sometimes imperfect 51
50. Hind tarsus ordinarily not more than eight times as long as thick, tibia often with reduced spurs; M_2 reduced only in Eubaphe; in the rest of full strength and associated with cubital stem; moths often stout; Sc very much swollen at base; hood above spiracle.....**Many Arctiidæ** (p. 42)

[7] Also most tropica l Thyrididæ.]

50. Hind tarsus ordinarily much more slender, the tibia with long spurs; M_2 usually well separated from cubital stem, though nearer it than radial, and often weaker than the other veins; Sc not more than twice as thick as R in their basal portion; usually slender moths; hood surrounding spiracle (fig. 16), except in some slender species.....Some **Noctuidæ** (p. 42)
51. Tympanic hoods enlarged dorsally, showing from dorsal side as two rounded bosses on the first segment of the abdomen, separated by a third of the width of the abdomen; brilliantly marked species.....**Pericopidæ**
51. Tympanic hoods less conspicuous dorsally; separated by half the width of the abdomen 52
52. White or yellow species with palpi not reaching the middle of the smooth-scaled front, and four-branched Cu in both wings; hood above spiracle, conspicuous .....**Arctiidæ (Haploa)** (p. 42)
52. Species with longer palpi, three-branched Cu in hind wings or gray ground color; and lateral hood.....Most **Noctuidæ** (p. 42)
53. Fore wing with raised scale-tufts; small species with Sc and R ordinarily fused to near middle of cell but free at base.....**Nolidæ** (p. 43)
53. Fore wings smoothly scaled.....54
54. Sc and R of hind wings fused at a point about middle of cell or connected by a cross vein, or closely parallel.....Most **Lymantriidæ**
54. Sc and R fused from base to middle of cell.
Most **Lithosiidæ** and *Menopsimus* **(Noctuidæ)** (p. 42)
54. Sc sharply divergent from R at base, then angulate and becoming closely approximate or fusing with it.....A few **Geometridæ** (p. 41)
55. Legs lost, moth never leaving cocoon.....**Psychidæ** (♀s in part) (p. 140)
55. With normal legs.....56
56. Cocoon seedlike, with a valve at one end (being formed of the larval case), the moth normally not leaving it; moth less than 6 mm. long.
Psychidæ (♀s in part) (p. 140)
56. Cocoon normally felted of the larval hair, or rudimentary and underground; moth more than 6 mm. long.....57
57. Ocelli present.....A few Arctic **Noctuidæ** (p. 42)
57. Ocelli absent 58
58. Abdomen closely scaled, or spined, or with bristling, dark gray hair.
Geometridæ (a few ♀s) (p. 41)
58. Abdomen smoothly clothed with fine light woolly hair; moth not normally leaving the cocoon, which is composed of the larval hair.
Liparidæ (a few ♀s) (p. 42)
59. Maxillary palpi conspicuous, folded in resting position (fig. 49).....60
59. Maxillary palpi straight and porrect (fig. 3), or rudimentary.....64
60. Antenna with large eye-cap, larger than eye.....61
60. Eye-cap rudimentary or absent; fore wing with large cell and branched veins..62
61. Fore wing with branched veins, normally with a small, four-sided cell (figs. 52–57) .....**Nepticulidæ** (p. 79)
61. Fore wing with three or four simple veins only (fig. 113)..**Opostegidæ** (p. 160)
62. Head entirely smooth, R_5, when distinct, running to costa (fig. 114).
Oinophilidæ
62. Head with a few erect hairs; R_5 present and running to outer margin (fig. 202) .....**Yponomeutidæ (Acrolepia)** (p. 343)
62. Head tufted, at least on vertex; R_5 running to costa.....63
63. Wing membrane aculeate (fig. 30); Sc of hind wing with a strong basal fork (the lower fork being R_1), or considerably swollen at base, R and Sc usually sharply divergent from base; vertex very rough (figs. 43–45).
Most **Incurvariidæ** (p. 72)

63. Wing membrane not aculeate; R_1 rarely as strong as the other veins, and when distinct separated from the base of the wing by several times its length (fig 73) ..... **Tineidæ** (p. 116)
64. Cell set obliquely in wing, twice as near inner margin as to costa at outer end; with one or both cubitals very short and running directly across to inner margin (figs. 123, 175) 65
64. Cell lying in center of wing, or, rarely, oblique, but with both Cu_1 and Cu_2 long and longitudinal; rarely obsolete (figs. 129, 185) 67
65. Hind wing lanceolate; **R** and M_1 widely separated, parallel (fig. 175). **Blastobasidæ** (p. 308)
65. Hind wing linear, **R** and M_1 connate or stalked 66
66. Fore tibia exceptionally slender, with epiphysis rudimentary, at its apex, or absent; antennæ turned forward in repose ..... **Coleophoridæ** (p. 202)
66. Fore tibia usually stout, the epiphysis conspicuous and situated at its middle; antennæ folded back in repose ..... A few **Lavernidæ** (p. 318)
67. Membrane of hind wing distinctly excavated below apex, with pointed, produced apex; rarely bifid (figs. 156, 160, etc.) ..... **Gelechiidæ** (p. 255)
67. Hind wing rounded at apex or trapezoidal, often broader than its fringe; anal region developed (fig. 138, etc.) 68
67. Hind wing lanceolate and pointed or linear, much narrower than its own fringe (fig. 180) 81
68. Hind wing with both M_1 and M_3 lost; **1st A** lost in fore wing (fig. 291). **Carposinidæ** (p. 513)
68. Hind wing with at most one vein lost 69
69. Vestiture of thorax and legs of deep spatulate hair; tongue obsolete, body usually stout; venation complete, with base of media preserved 70
69. Vestiture of thorax and fore and middle tibiæ mostly of normal scales; body usually slender 71
70. Palpi upturned beyond middle of front, usually beyond vertex, or long and porrect; with very long first joint; eyes usually hairy. **Tineidæ (Acrolophinæ)** (p. 116)
70. Palpi small, not reaching middle of front; eyes naked ..... **Cossidæ** (p. 516)
71. Cu_2 arising less than three-fourths way out on cell (fig. 234); palpus beak-like with second joint rough and usually porrect or oblique, and third small (figs. 241 to 243, and 271 to 283, inclusive) ..... **Tortricidæ** (p. 376)
71. Cu_2 arising more than three-fourths way out on cell or (rarely) palpus smooth and upturned beyond vertex (fig. 147) 72
72. Palpus rough-scaled and beak-like, with second segment roughly scaled on upper side, and third porrect, inconspicuous; **1st A** lost; **R** and M_1 closely approximate or stalked (fig. 288) ..... **Phaloniidæ** (p. 499)
72. Palpus weak and hardly projecting beyond front, or rudimentary; tongue rudimentary; female (so far as known) with abdomen heavily tufted at apex; **R** and M_1 normally separate but strongly divergent (figs. 103, 104) 73
72. Palpus bristled on outer side of second segment, sometimes with a mass of bristles, third segment ovoid, well set off, sometimes porrect; **R** and M_1 normally separate 74
72. Palpus upturned to middle of front or beyond, second joint long and slender, usually tapering 75
73. Male antennæ simple or bristled in American species, female with abdominal tuft ..... **Psychidæ** (p. 140)
73. Male antennæ plumose; female unknown ..... **Epipyropidæ**
74. Wing membrane not spinulated; antennæ shorter than fore wing. **Tineidæ** (p. 116)
74. Wing membrane spinulated; antennæ of male much larger than fore wing; ovipositor chitinized, piercing ..... **Incurvariidæ** (p. 72)

75. **R** and M_1 of hind wing closely approximated or stalked; tongue usually present (fig. 152) 76
75. **R** and M_1 well separated at origin, usually half as far as at margin (fig. 137); **1st A** usually preserved at margin 79
76. Wings heavy and stiff, close-scaled; normally with all veins present and separate, R_5 running to outer margin, **1st A** lost; maxillary palpi absent. **Thyrididæ** (p. 521)
76. Body and wings light, and soft-scaled; maxillary palpi perceptible, folded 77
77. R_4 and R_5 stalked or united, both running to costa (fig. 155); **1st A** lost. **Gelechiidæ** (p. 255)
77. R_4 and R_5 separate, or forking over apex, all veins present; **1st A** strong 78
78. Fore wing blunt, maxillary palpi of folded type ..... **Xyloryctidæ** (p. 250)
78. Fore wing falcate, maxillary palpi minute, but porrect. **Yponomeutoidea** (*Cerostoma*) (p. 341)
79. R_5 running to costa (fig. 141) ..... **Œcophoridæ** (p. 230)
79. R_5 running to outer margin or fore wing with not more than nine veins arising from cell 80
80. R_4 and R_5 stalked, forming over apex; ocelli minute or absent (fig. 138). **Œcophoridæ** (p. 230)
80. R_4 and R_5 separate (fig. 200), or ocelli very large ..... **Yponomeutoidea** (p. 335)
81. Antennæ with eye-cap, when folded back covering major part of eye 82
81. Antennæ with rudimentary eye-cap or none 83
82. Palpi small and drooping or absent ..... **Lyonetiidæ** (p. 148)
82. Palpi reaching beyond middle of front ..... A few **Gracilariidæ** (p. 161)
83. Head with long, bristly vestiture covering vertex and face; tongue and maxillary palpi absent ..... A few **Tineidæ** (p. 116)
83. Face at least smooth-scaled 84
84. Hind wing with radial stem central, sending off a branch to costa near middle (R_{2+3}) and one to dorsal margin nearer apex (fig. 131). **Douglasiidæ** (p. 224)
84. **R**-stem not sending a branch to costa, or with the branch close to apex (fig. 181, etc.) 85
85. Hind wing lanceolate, at least a sixth as wide as long, with the **R**-stem running through its center (fig. 134) 86
85. Hind wing with **R**-stem closely associated with **Sc** toward base, or lost; or wing linear with veins crowded (figs. 180, 186) 88
86. Maxillary palpi distinct, porrect ..... A few **Gracilariidæ** (p. 161)
86. Maxillary palpi obsolete 87
87. **Cu**-stem of hind wing at least two-branched (fig. 129); cell usually formed; palpi usually upturned beyond middle of front ..... **Cycnodiidæ** (p. 218)
87. **Cu**-stem of hind wing simple, free; palpi small, drooping (fig. 134). **Heliozelidæ** (p. 225)
88. Fore wing linear, with three or four simple veins only (fig. 221). **Heliodinidæ** (*Cycloplasis*) (p. 356)
88. Fore wing lanceolate with branched veins but no cell (fig. 133). **Heliozelidæ** (*Coptodisca*) (p. 225)
88. Fore wing with formed cell 89
89. Fore wing with only four veins running to costa, and five or six to inner margin (fig. 202), or hind wing with M_1 widely separated from **R** at origin, often stalked with M_2 ..... Some **Yponomeutoidea** (p. 335)
89. Fore wing with five veins running to costa or only three or four to inner margin; **R** and M_1 approximate or stalked to hind wing 90
90. Vertex rough or with a rough anterior crest 91
90. Entire head smooth-scaled ..... **Lavernidæ** (p. 318)
91. Accessory cell small or more often absent (figs. 115–120) hind tibiæ less hairy, often smooth or bristled ..... **Gracilariidæ** (p. 161)

91. Accessory cell very large, extending halfway to base of fore wing (fig. 106); hind tibiæ with a large mass of loose hair.....Tischeriidæ (p. 145)

Larva [8]

1. Thoracic legs wanting or reduced to fleshy swellings, without chitinized segments 2
1. Thoracic legs developed, with chitinous segments.....8
2. Body fusiform, thickest at middle, head small with closed front (separated from the vertex by the epicrania).....Incurvariidæ (Prodoxus) (p. 72)
2. Body cylindrical or flattened; when somewhat fusiform with front reaching vertex 3
3. Head with six small ocelli on each side.....4
3. Head with two ocelli on each side, front not reaching vertex. Heliozelidæ (p. 225)
3. Head with a single large ocellus on each side, or none.....5
4. Abdomen with rudimentary ventral prolegs on third to sixth segments, bearing hooks .....Tischeriidæ (p. 145)
4. Abdomen without prolegs on sixth segment.....Gracilariidæ (p. 161)
5. Ocellus frontal, front triangular.....Eriocraniidæ (p. 64)
5. Ocellus lateral, front quadrangular.....6
6. Front widest at posterior end, body normally depressed, prolegs on third to fifth segments of abdomen when present.....Gracilariidæ (p. 161)
6. Front widest at anterior end, body cylindrical; rudimentary prolegs on second to seventh segments of abdomen or none.....7
7. Body normal, five times as long as thick, normally with prolegs. Nepticulidæ (p. 79)
7. Body very slender, ten times as long as thick, without prolegs. Opostegidæ (p. 160)
8. Setæ replaced by large, ovate scales, arranged in pairs...Micropterygidæ (p. 62)
8. Setæ normal 9
9. Crochets wanting, prolegs rudimentary or absent.....10
9. Prolegs at least represented by rudimentary crochets.....13
10. Front extending obviously to vertex; small species.....Coleophoridæ (p. 202)
10. Front not extending to vertex (except when vertex is represented by a very narrow slit) 11
11. Head completely retracted, body frequently with spines or secondary hair, the primary setæ obsolete; body with obscure incisures, usually with conspicuous pits .....Eucleidæ (p. 102)
11. Head normally exposed; body with primary setæ only, which are usually distinct; with strong incisures.....12
12. Setæ iv and v distant on abdomen; prolegs present, though without hooks (fig. 51).....Incurvariidæ (Tegeticula) (p. 72)
12. Setæ iv and v adjacent (fig 174); prolegs absent.....A few Gelechiidæ (p. 255)
13. Body without secondary or tufted setæ, tubercle vi single; vii of three setæ at most, unless the proleg has a multiserial circle of hooks, when it may have four setæ; sometimes with a couple of dorsal subprimary setæ....14
13. Body with tufted or secondary hair; at least two setæ on tubercle vi on sixth segment of abdomen, or with additional setæ on proleg.....48
14. Sixth segment of abdomen without a proleg.....Gracilariidæ (p. 161)
14. Sixth segment of abdomen with a proleg, the more anterior segments sometimes without 15
15. Hooks of prolegs arranged in a circle or ellipse (sometimes interrupted), or in transverse bands 16

[8] Modified from the key in *The Classification of Lepidopterous Larvæ*, by S. B. Fracker Illinois Biological Monographs, volume 2, number 1.

15. Hooks of prolegs in a single band, sometimes with a few rudimentary outer hooks besides 42
16. Prespiracular wart of prothorax with two setæ (fig. 319)....17
16. Prespiracular wart of prothorax with three setæ (fig. 174)....18
17. Hooks uniordinal (fig. 25), body cylindrical, vii of mesothorax with a single seta ....Orneodidæ (p. 652)
17. Hooks biordinal or triordinal (figs. 26, 27), or uniordinal in larvæ with stout fusiform body and bisetose tubercle vii of mesothorax Pyralididæ (p. 523)
18. Hooks of prolegs arranged in two transverse bands (fig. 107)....19
18. Hooks in a circle or ellipse, sometimes broadly interrupted (figs. 42, 233)..24
19. Prolegs with two simple series of hooks....20
19. Prolegs with a single series of hooks, or with two bands formed of several series of alternate hooks (fig. 51)....Incurvariidæ (p. 72)
20. Setæ iv and v of abdomen remote....Lyonetiidæ (Bucculatrix) (p. 155)
20. Setæ iv and v of abdomen adjacent (fig. 319)....21
21. Hooks of anal prolegs in two groups....Gelechiidæ (p. 255)
21. Hooks of anal prolegs in a single series....22
22. Front extending about one-third way to vertex....Cossidæ (*Cossula*) (p. 516)
22. Front extending at least two-thirds way to vertex....23
23. Spiracles elliptical, normal in size, those of eighth segment of abdomen higher than the others....Ægeriidæ (p. 360)
23. Spiracles very small, circular, the last pair about in line..Coleophoridæ (p. 202)
24. Setæ iv and v of abdomen remote, or, in a few minute species, v absent....25
24. Setæ iv and v adjacent, often on a common tubercle, no small hooks at base of principal series on prolegs....30
25. Hooks arranged in a single complete ellipse....26
25. Hooks arranged in a broken ellipse, or with additional rudimentary series at the base of the normal ones (fig. 28)....28
26. Prothorax with setæ of prespiracular group about as far from spiracle as from each other; seta i on abdomen higher than ii....Lyonetiidæ (p. 148)
26. Prothorax with setæ of prespiracular group about twice as far from spiracle as from each other....27
27. Seta i of abdomen, much lower than ii (fig. 92)....Tineidæ (p. 116)
27. Seta i of abdomen not lower than ii....Heliodinidæ (p. 356)
28. Mesothorax and metathorax with seta ia in front of ib and well separated, abdomen with iv above level of spiracle (fig. 42)....Hepialidæ (p. 66)
28. Mesothorax and metathorax with setæ ia and ib closely associated; abdomen with iv below level of spiracle....29
29. Prothorax with seta *beta* higher (nearer mid-dorsal line) than *alpha* (fig. 91). Tineidæ (Acrolophinæ) (p. 116)
29. Prothorax with seta *beta* lower than *alpha*....Yponomeutidæ (p. 337)
30. Last pair of spiracles dorsal, closer together on middle line than setæ i of anterior abdominal segments (fig. 293)....Carposinidæ (p. 513)
30. Last pair of spiracles nearly normal....31
31. Mesothorax with two setæ vii (above base of leg)....32
31. Mesothorax with a single seta vii; ninth abdominal segment with seta ii higher than i....33
32. Prothoracic spiracle with long axis vertical; ninth abdominal segment with seta i higher than ii....Thyrididæ (p. 521)
32. Prothoracic spiracle with long axis horizontal.... Psychidæ (p. 140)
33. Setæ ii of ninth abdominal segment closer together than on any other, frequently on the same plate (fig. 290)....34
33. Setæ ii of ninth abdominal segment as far apart as on the other segments, very rarely (Zeuzera) on the same plate....35
34. Abdomen with setæ iv and v practically horizontally placed; hooks of prolegs uniordinal ....Phaloniidæ (p. 499)

34. Abdomen with setæ iv and v in a diagonal or vertical line; hooks usually multiordinal (fig. 27) ..... **Tortricidæ** (p. 376)
35. Coxæ of metathoracic legs twice as far apart as wide; prolegs small; small species (fig. 194) ..... **Lavernidæ** (p. 318)
35. Coxæ of metathoracic legs closer together 36
36. Setæ i and ii adjacent on abdominal segments.
Heliodinidæ (*Schreckensteinia*) (p. 356)
36. Setæ i and ii widely separated 37
37. Front reaching less than half way to vertex (about half way in some very large species with horizontal head and triordinal hooks) 38
37. Front reaching two-thirds way to vertex or a little shorter, and ending in an attenuate point; small species with uniordinal or biordinal hooks 39
38. Borers; abdomen with setæ iv and v on separate tubercles on the ninth segment (fig. 296) ..... **Cossidæ** (p. 516)
38. Leaf feeders; abdomen with setæ iv and v on the same tubercle on the ninth segment ..... **Xylorictidæ** (*Stenoma*) (p. 250)
39. Hooks of prolegs biordinal 40
39. Hooks of prolegs uniordinal 41
40. Second, third, and fourth ocelli grouped together, more widely separated from first and lower (fig. 149) ..... **Œcophoridæ** (p. 230)
40. Ocelli evenly spaced[9] ..... **Gelechiidæ** (p. 255)
41. Abdomen with iii farther back than spiracle on eighth segment[9].
Blastobasidæ (p. 308)
41. Abdomen with seta iii not farther caudad than spiracle.
Glyphipterygidæ (p. 350)
42. Prespiracular wart on prothorax with three setæ (figs. 150, 151) 43
42. Prespiracular wart on prothorax with two setæ 44
43. Setæ iv and v of abdomen remote; or, if approximate, setæ *beta* much closer together than setæ *alpha* on prothorax (like fig. 210) and prolegs long and slender ..... **Yponomeutidæ** (p. 337)
43. Setæ iv and v close together; *beta* about as far apart as *alpha*; prolegs usually short ..... **Œcophoridæ** (*Ethmia*) (p. 244)
44. Tubercle vii on mesothorax and metathorax with two setæ 45
44. Tubercle vii on mesothorax and metathorax with a single seta 47
45. Setæ minute, tubercles reduced to obscure rings, head unusually wide; and prolegs reduced ..... **Thyatiridæ** (p. 686)
45. Setæ heavy, almost always spinulose, on conspicuous tubercles 46
46. Tubicle iii of abdomen with two setæ ..... **Lithosiidæ** (p. 42)
46. Seta iii of abdomen single ..... **Arctiidæ** (*Utetheisa*) (p. 42)
47. North American species with enlarged, contrasting tubercles; and a hump on eighth segment of abdomen; contrastingly striped transversely (or spotted) with black ..... **Agaristidæ** (p. 42)
47. Caterpillars of other types ..... **Noctuidæ** (p. 42)
48. Larvæ with less than the normal number of ventral prolegs; or with the first pair of ventrals much reduced 49
48. Larvæ with the normal four pairs of ventral prolegs; the anals sometimes reduced 50
48. Larvæ with additional prolegs without hooks ..... **Megalopygidæ** (p. 101)
49. Hair tufted; hooks of prolegs uniordinal; 14 legs ..... **Nolidæ** (p. 43)
49. With a few subprimary hairs only (in some exotic species with fine secondary hair), sometimes with only a single subventral subprimary on sixth segment of abdomen; usually 10 legs ..... **Geometridæ** (p. 41)
50. Anal prolegs wholly lost ..... **Drepanidæ** (p. 688)
50. Anal prolegs represented by a pair of large tubercles, or flagella at least, normally fully developed 51

[9]These characters are said to be inconstant but none are better known to me.

51. Hooks of prolegs uniordinal (fig. 25)....52
51. Hooks of prolegs biordinal or triordinal (figs. 26, 27)....66
52. Warts rudimentary or absent, or obscured by secondary hair....53
52. At least wart vi (subventral) many-haired and distinct, secondary hairs sparse or absent above prolegs....60
53. Anal plate bifurcated, head roughly papillose; third ocellus very large. **Nymphalidæ (Satyrinæ)** (p. 44)
53. Anal plate simple; head smoother; third ocellus rarely much enlarged....54
54. Larva parasitic, with hemispherical body and a complete circle of uniordinal hooks....**Epipyropidæ**
54. Larva more normal in shape, not parasitic....55
55. Spiracles small, circular; ventral prolegs slender, more or less stem-like, with expanded planta....**Pterophoridæ** (p. 639)
55. Spiracles elliptical, larger; ventral prolegs short....56
56. Secondary setæ dense....57
56. Secondary setæ very sparse or absent above prolegs; with simple setæ or a few subprimaries....58
57. Notch of labrum deep, with parallel sides; anal prolegs full as strong as the others; with warts more or less overshadowed by the secondary hair. A few **Noctuidæ** (p. 42)
57. Notch acute, with convergent sides; anal prolegs much reduced and not used; warts rudimentary and dominated by a single hair (Melalopha) or absent (Datana)....**Notodontidæ** (p. 42)
58. Tubercle iv at about the same level on abdominal segments 6, 7, and 8. **Liparidæ** (*Doa*)
58. Tubercle iv much lower on seventh than on other segments; anal prolegs more or less reduced or modified....59
59. Skin shagreened....**Dioptidæ**
59. Skin not shagreened....Most **Notodontidæ** (p. 42)
60. Eversible mid-dorsal glands on two segments of abdomen....**Liparidæ** (p. 42)
60. No eversible dorsal glands....61
61. Spiracles circular, small....62
61. Spiracles elliptical, normal in size....63
62. Ventral prolegs short, with a straight band of heavy hooks. **Pyromorphidæ** (p. 113)
62. Ventral prolegs slender, with an expanded planta sometimes bearing a circle of hooks....**Pterophoridæ** (p. 639)
63. Mesothorax with only a single large wart above level of spiracles. **Euchromiidæ** (p. 43)
63. Mesothorax with two or three warts above level of spiracles....64
64. Wart (or seta) iv at about the same level on seventh abdominal segment as on the sixth and eighth....**Arctiidæ** (p. 42)
64. Wart (or seta) iv much lower on seventh segment or absent (perhaps fused with v)....65
65. Hooks of prolegs even in length, or gradually becoming smaller at ends of row....A few **Noctuidæ** (p. 42)
65. Hooks of prolegs abruptly decreasing in size near each end....**Pericopidæ**
66. Body without general secondary hair, often with a few subprimaries; with not more than eight hairs on prolegs....67
66. Body with numerous secondary setæ, at least on the prolegs; anal prolegs always well developed....72
67. Hooks in a complete circle (fig. 412)....68
67. Prolegs with a band of hooks on inner side, sometimes supplemented with a much weaker band on outer side....70
68. Subdorsal setæ of abdomen represented by warts. **Yponomeutidæ** (*Scythris*) (p. 349)

68. Subdorsal setæ of abdomen simple.....69
69. Head rugose, body widest at proleg-bearing segments....Lacosomidæ (p. 656)
69. Head smooth, body widest at first segment of abdomen.
Xylorictidæ (*Ptochoryctis*) (p. 250)
70. Prespiracular wart of prothorax with three setæ; setæ iv and v of abdomen approximate (fig. 151).....Œcophoridæ (*Ethmia*) (p. 244)
70. Prespiracular wart of prothorax with two setæ; setæ iv and v of abdomen usually distant 71
71. First and last spiracles twice as large as the others.....Epiplemidæ (p. 654)
71. Spiracles subequal.....Thyatiridæ (p. 686)
72. Setæ very irregular in length, some ten times as long as others; with obscure warts, at least in younger stages, sometimes with spatulate scale-hairs..73
72. Setæ subequal or supplemented by prominent warts or by spines.....74
73. Labrum notched two-thirds of its depth, or with the notch somewhat shallower and continued as a groove to the base of the labrum; North American species with small dorsal hair pencils.....Eupterotidæ (*Apatelodes*) (p. 678)
73. Labrum less deeply notched, the notch not continued by a groove; no dorsal hair pencils.....Lasiocampidæ (p. 679)
74. Eighth segment of abdomen with a mid-dorsal horn, plate, or tubercle.....75
74. Eighth segment of abdomen not armed in mid-dorsal line.....79
75. Body with numerous branching spines or enlarged tubercles.....76
75. Body with at most two pairs of small spines on thorax.....78
76. Head angulated or spined dorsally, or abdomen with several mid-dorsal spines; hooks of prolegs usually triordinal (fig. 27).....Nymphalidæ (p. 44)
76. Head evenly rounded; hooks biordinal (fig. 26).....77
77. A mid-dorsal spine on ninth segment of abdomen; spines of body segments strongly unequal, and armed with short nodules or spiracles (fig. 423).
Citheroniidæ (p. 664)
77. No mid-dorsal spine on ninth segment, or body spines subequal and armed densely with long poison-spinules (fig. 418).....Saturniidæ (p. 668)
78. Segments with six or eight annulets, prolegs normal in position.
Sphingidæ (p. 42; 360)
78. Segments with two or three obscure annulets; prolegs unusually widely separated.....Bombycidæ (p. 679)
79. Head high, triangular.....Sphingidæ (*Lapara*) (p. 42)
79. Head not triangular 80
80. An inconspicuous mid-dorsal spine on ninth abdominal segment.
Citheroniidæ (*Anisota*) (p. 664)
80. No mid-dorsal spines.....81
81. Hooks in an ellipse, at most narrowly interrupted.....Hesperiidæ (p. 43)
81. Hooks in one band, occasionally interrupted, rarely in two widely separated bands 82
82. Band of hooks reduced or interrupted at middle.....83
82. Principal band of hooks continuous.....84
83. Head half diameter of body; secondary hair relatively prominent.
Erycinidæ (p. 44)
83. Head rarely more than a third as wide as body; secondary hair less prominent .....Lycænidæ (p. 44)
84. A forked, eversible dorsal gland just behind head (osmeterium).
Papilionidæ (p. 44)
84. No osmeterium 85
85. Body with branching spines, high hairy tubercles, fleshy filaments, bifurcated anal plate or angulated or spined head.....Nymphalidæ[10] (p. 44)

[10] The western Saturniid genera, Agapema and Saturnia, will run here. They have regular, branching spines, strong prolegs, and a small, smooth head, unlike any Nymphalidæ known to me.

5. Body without spines, warts, or filaments; anal plate rounded, head rounded...86
6. Head larger than prothorax (Anæa), or legs with reduced hooks on outer side (Libythea) ..... **Nymphalidæ** (p. 44)
6. Head smaller than prothorax, legs with a single band of hooks only. **Pieridæ** (p. 44)

Pupa[11]

1. Mandibles large, movable, crossing in front of the face. **Micropterygidæ** (p. 62); **Eriocraniidæ** (p. 64)
1. Mandibles small, fixed, or obsolete.....2
2. Fourth abdominal segment movable on the third; or appendages free from each other and dorsal head-piece longer than prothorax measured on mid-dorsal line 3
2. Fourth abdominal segment fixed to third; appendages fused to each other, and almost always to body wall.....22
3. Maxillary palpi present, separated by a suture from maxillæ.....4
3. Maxillary palpi absent or represented merely by lateral extensions of the maxillæ 11
4. Dorsum of abdomen with a covering of fine spines, not arranged in rows; dorsal head-piece longer than prothorax on mid-dorsal line.....5
4. Several abdominal segments each with a row of spines near the anterior edge, sometimes with a second posterior row, but with scattered spines rudimentary or absent.....7
5. Maxillary palpi distinct, extending as a band along posterior margin of eye....6
5. Maxillary palpi minute, not extending along posterior margin of eye. A few **Gracilariidæ** (p. 161)
6. Abdominal segments with irregular areas of diffuse spinules only; first segment with spiracle exposed.....**Nepticulidæ** (p. 79)
6. Abdominal segments each with an anterior row of spines, more prominent than the area of fine spinules; first segment with spiracles covered by wings. **Incurvariidæ** (p. 72)
7. Abdomen with two rows of spines on each of the middle segments.....8
7. Abdomen with the anterior rows of spines only.....10
8. Cremaster represented by a tuft of spines or absent, no spines on the anal rise; wings narrow and pointed; large spines present on venter of tenth abdominal segment ..... **Ægeriidæ** (p. 360)
8. Cremaster specialized, forming a definite process, or spines present on anal rise; wings broad, not pointed; no large spines on venter of tenth segment.....9
9. Last abdominal segment with a group of angular nodules, overshadowing the setæ. Maxillary palpi going with tongue on dehiscence..**Phaloniidæ** (p. 499)
9. Last abdominal segment with prominent setæ. Maxillary palpi separating from tongue on dehiscence.....**Tortricidæ** (p. 376)
10. Mesonotum produced in a long lobe in mid-dorsal line, the metathorax less than a quarter as long.....**Glyphipterygidæ** (p. 350)
10. Mesonotum not produced in a lobe; metathorax rarely less than half as long. **Tineidæ** (p. 116)
11. Dorsal head-piece much longer than prothorax on middle line, often twice as long; dorsum of abdomen with scattered fine spines, rarely dominated by a stronger anterior row.....12
11. Dorsal head-piece not longer than prothorax (sometimes not separated from the other sclerites).....16
12. Antennæ extending half the length of the wings; labrum very long and lobe-like, covering a fourth of labial palpi.....**Heliozelidæ** (p. 225)

[11] Based on the keys in *A Classification of the Lepidoptera, based on Characters of the Pupa*, by Dr. Edna Mosher, in the bulletin of the Illinois State Laboratory of Natural History vol. 12, article 2.

12. Antennæ extending at least three-fourths the length of the wings; labrum normal 13
13. Fourth segment of abdomen free from third; antennæ and hind legs not subequal in length, and seldom extending beyond tip of wings 14
13. Fourth segment soldered to third; antennæ and hind legs subequal and extending beyond tip of wings 15
14. Labial palpi visible; last segment with two dorsal spines; setæ i closely approximate on mid-dorsal line on middle abdominal segments ... **Tischeriidæ** (p. 145)
14. Labial palpi invisible; last segment with two lateral spines; setæ i normal, well separated ..... **Lyonetiidæ** (*Bucculatrix*) (p. 148)
15. Abdominal segments 3 to 7 each with two deep punctures at the anterior margin near the mid-dorsal line; segments 8 to 10 together shorter than segment 7, not separated by distinct incisures.
Lyonetiidæ (*Phyllocnistis*) (p. 148)
15. No such pits on dorsum; abdominal segments 8 to 10 relatively longer.
Gracilariidæ (p. 161)
16. Cremaster developed with a distinct stem, longer than thick.
Tortricidæ (*Peronea*) (p. 376)
16. Cremaster not developed, its hooks attached directly to body 17
17. Body heavily chitinized; dorsal spines or setæ on abdomen in transverse rows; first abdominal spiracles invisible 20
17. Body lightly chitinized; dorsal spines irregular; spiracles visible on first abdominal segment 18
18. Abdominal segments with spines on anterior part and setæ on posterior part; large conical tubercles behind several abdominal spiracles.
Megalopygidæ (p. 101)
18. Abdominal segments without areas of fine setæ; no tubercles behind the spiracles 19
19. Labial palpi exposed between maxillæ, which are less than half length of wings ..... **Eucleidæ** (p. 102)
19. Labial palpi concealed by maxillæ, which are more than half length of wings.
Pyromorphidæ (p. 113)
20. Mesothorax less than twice as long as metathorax; maxillæ quadrangular, widely separated, divergent ..... **Hepialidæ** (p. 66)
20. Mesothorax more than twice as long as metathorax; maxillæ longitudinal, their tips often meeting in midventral line; or all appendages obsolete 21
21. Third abdominal segment movable on second; segments with an anterior row of spines and a posterior row of setæ ..... **Psychidæ** (p. 140)
21. Third abdominal segment fixed; segments with anterior and posterior rows of spines ..... **Cossidæ** (p. 516)
22. Pilifers distinct, the labrum with three lobes, usually separated by a T-shaped suture (fig. 29) 23
22. Pilifers absent, labrum simple or obscurely bilobed 31
23. Maxillary palpi present; antennæ never fusiform and wider toward apex; fore femora usually visible 24
23. Maxillary palpi absent 25
24. Epicranial suture absent, fronto-clypeal about half visible; eighth segment of abdomen free from the seventh in male; no deep dorsal furrow between ninth and tenth segments of abdomen ..... **Yponomeutidæ** (*Atteva*) (p. 337)
24. Epicranial suture distinct at sides; sometimes running into suture between head and thorax at middle (except in the Phycitinæ which have a deep groove between ninth and tenth segments of abdomen); fronto-clypeal suture absent; eighth segment fixed ..... **Pyralididæ** (p. 523)
25. A deep groove between ninth and tenth abdominal segments dorsally; fore femora exposed ..... **Pyralididæ (Epipaschiinæ)** (p. 604)
25. No deep groove between ninth and tenth segments 26

6. Antennæ not swollen, fore and middle legs extending between eyes and antennæ; fore femur normally exposed.....**Pterophoridæ** (p. 639)
6. Antennæ swollen outwardly; fore legs abutting squarely on eyes, middle legs sometimes extending between eyes and antennæ, fore femur concealed (butterflies).....27
7. Outer angles of maxillæ in contact with eyes; tongue often projecting beyond tips of wings; pupa normally in a cocoon.....**Hesperiidæ** (p. 43)
7. Maxillæ separated from tongue; tongue reaching just to tips of wings; pupa normally exposed.....28
8. Middle legs not reaching forward to eyes; pupa girt about the middle, or rarely in a cocoon.....29
8. Middle legs reaching forward to eyes, and often between eyes and antennæ; pupa suspended by tail only, or rarely in a cocoon.....**Nymphalidæ** (p. 44)
9. Tongue falling short of tip of wings, pupa rounded.....**Lycænidæ** (p. 44)
9. Tongue almost always reaching tip of wings.....30
0. Anterior end of pupa with two points.....**Papilionidæ** (p. 44)
0. Anterior end of pupa with a single point.....**Pieridæ** (p. 44)
1. Fore wings extending far beyond the posterior edge of the fourth abdominal segment in the midventral line; fore femora and almost always labial and maxillary palpi exposed; fronto-clypeal suture obsolete; prothorax noticeably narrower on mid-dorsal line than at sides; antennæ very rarely in contact on midventral line.....32
1. Fore wings not extending beyond the posterior edge of the fourth abdominal segment; or fore femora and labial palpi concealed, or fronto-clypeal suture distinct; prothorax usually subquadrate; maxillary palpi often covered....34
2. Pupa incapable of motion; maxillary and labial palpi concealed.
Lyonetiidæ (p. 148)
2. Pupa with several free segments; labial palpi exposed.....33
3. Maxillary palpi present; caudal end of body without lateral projections ending in spines.....**Yponomeutidæ** (p. 337)
3. Maxillary palpi absent; caudal end of body with lateral projections ending in spines.....**Coleophoridæ** (p. 202)
4. Fore wings extending well beyond fourth abdominal segment, or abdomen depressed, with incisures much deeper dorsally and ventrally than on sides, and capable mainly of dorso-ventral motion; antennæ in contact on middle line; first four segments of abdomen usually longer than the remainder; epicranial suture present, maxillary palpi usually, and femora and labial palpi rarely, present.....35
4. Fore wings not extending beyond fourth segment, or maxillary palpi absent; abdomen not depressed and specialized for dorso-ventral motion; first four abdominal segments rarely longer than the others; epicranial suture rarely visible.....42
5. Maxillary palpi absent; no movable segments; a specialized cremaster present; pupa suspended and girt like that of a butterfly; tongue as long as fore legs.....**Cycnodiidæ** (p. 218)
5. Maxillary palpi present, and body capable of dorso-ventral motion, except in a few genera which have no cremaster; tongue longer than middle legs, reaching antennæ, except in Ethmia.....36
6. Antennæ four-fifths as long as fore wings, meeting only at their apex; labial palpi large, maxillaries minute, fronto-clypeal suture complete, strongly sinuate of middle; most of setæ hooked..**Yponomeutidæ** (*Scythris*) (p. 337)
6. Antennæ reaching almost or quite to tip of wings, coming in contact at two-thirds length of wings, and often diverging again at apex; labial palpi concealed unless fore femora are exposed.....37
7. Antennæ not diverging after coming in contact.....38
7. Antennæ diverging at apex; three flexible incisures on abdomen.....40

38. Tongue shorter than fore legs.....Œcophoridæ (*Ethmia*) (p. 244)
38. Tongue longer than fore legs.....3
39. Maxillary palpi large; labial palpi obsolete; fronto-clypeal suture complete; femora concealed.....A few Gelechiidæ (p. 255)
39. Maxillary palpi minute and fronto-clypeal suture interrupted; or maxillary palpi lost, or large in primitive species with fore femora exposed.
Lavernidæ (p. 318)
40. Fronto-clypeal suture complete, maxillary palpi large, in contact with bot fore and middle legs.....Gelechiidæ (p. 255)
40. Fronto-clypeal suture obsolete in middle.....4
41. Maxillary palpi large, no hooked setæ on venter of ninth abdominal segment.
Œcophoridæ (p. 230)
41. Maxillary palpi minute, distant from maxillæ; with hooked setæ on venter o ninth abdominal segment.....Xylorictidæ (p. 250)
42. Labial palpi exposed, lanceolate.....4
42. Labial palpi reduced to a minute area behind mouth, or lost.....4
43. Body with more or less dense secondary setæ (sometimes very minute) no arranged around the larval warts.....Lasiocampidæ (p. 679)
43. Body with primaries only, or with setæ arranged around the larval warts....4
44. Fore femora exposed.....4
44. Fore femora concealed.....4
45. A specialized cremaster or hooked cremastral setæ present; or middle legs no reaching to maxillary palpus or eye; or a special ridge developed on fifth segment of abdomen.....Noctuidæ (p. 42)
45. Abdomen ending in a group of pyramidal points, the setæ obscure, middle legs touching maxillary palpi; no special ridge on fifth segment.
Pyralididæ (*Diatræa*) (p. 590)
46. Body setæ not arranged in circles about the scars of the larval warts.
Agaristidæ (p. 42); Noctuidæ (p. 42)
46. Body setæ arranged in circles about the scars of the warts.....47
47. Tongue less than half as long as fore wings.....Liparidæ (p. 42)
Arctiidæ (*Halysidota*) (p. 42); Euchromiidæ (p. 43)
47. Tongue less than half as long as fore wings.....Liparidæ (p. 42)
48. Maxillary palpi preserved, close to antennæ; a dorsal crest on thorax and base of abdomen; no specialized cremaster.....Pyralididæ (Galleriinæ) (p. 532)
48. Maxillary palpi lost; rarely with a mid-dorsal keel; usually with a cremaster.....49
49. Antennæ distinctly swollen toward tip; cremaster obsolete.
Nymphalidæ (*Œneis*) (p. 44)
49. Antennæ not swollen toward tip; often pectinate; or cremaster well developed.....50
50. Setæ arranged in circles around the larval warts.....51
50. Setæ not arranged in circles around the larval warts.....53
51. Antennæ more than half as long as fore wings.....52
51. Antennæ less than half as long as fore wings.....A few Liparidæ (p. 42; 101)
52. A long cremaster, as long as ninth and tenth segments of abdomen together, with hooked setæ, abdomen without flanged plates.
Noctuidæ (Pantheinæ) (p. 42)
52. Cremaster rudimentary or without hooked setæ, in the latter case with flanged plates on abdomen.....Arctiidæ (p. 42)
53. Body covered with rather coarse, short secondary setæ, cremaster rudimentary.....Bombycidæ (p. 679)
53. Body covered with fine soft secondary setæ; cremaster strong, with recurved hooks.....Notodontidæ (*Melalopha*) (p. 42; 678)
53. Body with setæ simple, obscure, or mostly lost.....54

. Fronto-clypeal suture distinct at ends, resting on base of antennæ; antennæ never a fifth as wide as long; spiracular furrows frequent.....55
. Fronto-clypeal suture lost or rudimentary; antennæ almost always a fifth as wide as long; spiracular furrows rare.....59
. Antennæ extending beyond apex of wings; last four segments of abdomen with hooked dorsal setæ .....Dioptidæ
. Antennæ not extending beyond apex of wings; abdomen rarely if ever with hooked dorsal setæ.....56
. Antennæ usually considerably broader near the base, their greatest width usually greater than that of the prothoracic legs; antennæ usually more than three-fourths the length of the wings; if not, then the epicranial suture is present, or the cremaster is wanting, or if present, bifurcate at the distal end or bearing hooked setæ; dorsum of the abdomen usually with a deep furrow between the ninth and tenth segments; scar of a caudal horn never present on the dorsum of the eighth abdominal segment; labial palpi sometimes visible as small triangular or polygonal areas caudad of the labrum..57
. Antennæ rarely very much broader near the proximal end, usually filiform, their greatest width seldom greater than that of the prothoracic legs; if greater, then the cremaster is never wanting, nor bifurcate, nor with hooked setæ; antennæ never more than three-fourths the length of the wings; epicranial suture never present; dorsum of the abdomen never with a deep furrow between the ninth and tenth segments; scar of a caudal horn usually present on the dorsum of the eighth abdominal segment; labial palpi never visible.....Sphingidæ (p. 42)
. Maxillæ usually more than three-fifths the length of the wings; if not, then the caudal end of the body with hooked setæ, or the spiracles of the third abdominal segment concealed by the wings and those of the sixth segment farther ventrad than those of the other segments; prothoracic femora often exposed; a deep furrow usually present on the dorsum of the abdomen between the ninth and tenth segments; posterior margin of mesothorax never with a row of deep pits with smooth tubercle-like areas between.
Geometridæ (p. 41)
. Maxillæ seldom exceeding three-fifths the length of the wings; if so, then the posterior margin of the mesothorax with a row of deep pits with smooth, elevated, quadrangular tubercle-like areas between them; or with the entire body surface coarsely punctate; abdominal spiracles of the third segment never concealed by the wings, and those of the sixth never farther ventrad than the remainder; prothoracic femora never exposed; a furrow never present on the dorsum of the abdomen between segments 8 and 9 except in Datana, where the cremaster is T-shaped with recurved hooks.....58
. Maxillæ rudimentary; abdomen with flanged plates, not telescoping, the anterior one on each segment divided by transverse constrictions into the appearance of a row of beads.....Eupterotidæ (p. 678)
. Maxillæ developed; or abdominal segments not beaded, without flanged plates .....Notodontidæ (p. 42)
. Body with primary setæ only; iv and v distinct and approximated below spiracle .....Lacosomidæ (p. 656)
. Body with rudimentary secondary setæ; iv and v not recognizable.....60
. Pupæ with flanges on movable abdominal segments, not telescoping when dry 61
. Pupæ without flanges on movable abdominal segments, the posterior segments telescoping within the anterior ones when dry....Saturniidæ (p. 668)
. Cremaster distinct, bifurcate; metathorax with prominent subdorsal callosities; pupæ in the ground.....Citheroniidæ (p. 664)
. Cremaster rudimentary, represented by its hooks only; no callosities on metathorax; pupation at surface of ground, sometimes in a thin cocoon.
Saturniidæ (Hemileucinæ) (p. 669)

Order **LEPIDOPTERA**

Suborder **JUGATÆ**

Body and wings covered with minute spinules or aculeæ. Head (fig. 32), with ocelli, when developed, separated by a wide, unscaled space from the eyes; ocelli in the Hepialidæ rudimentary (Sthenopis) or absent. Antennæ without sense-cones, with aculeæ on their surface; in the North American species proportionately small and simple, but pectinate in exotic species. Clypeus separated by well-marked sutures from both front and labrum. Thorax loosely constructed, the metathorax fully half as large as the mesothorax and similar in structure; the halves of the metascutum usually meeting on the middle line. Fore wing (figs. 31, 36, 40) with subcosta more or less distinctly forked; humeral vein present; base of media preserved; jugum present, supported by the rudiments of a fourth and a fifth anal vein; with an oblique vein from **M** to **2d A** near base, which appears like a cross vein, but whose upper half is in fact a portion of cubitus (fig. 41). Hind wing with four or five branches of radius preserved, the venational plan about as in the fore wing, but with the oblique vein in the base of the anal region obscure. Jugum usually rudimentary or absent; frenulum composed of a series of weak bristles or absent.

Caterpillar with dorsal setæ placed similarly on mesothorax and metathorax, and on abdomen (figs. 39, 42). Eyes, when six, in an irregular group, when single, on face. Pupa with four or more movable segments, with mandible set off by a suture, or articulated.

The three families seem relics of an earlier age, and are not closely related.

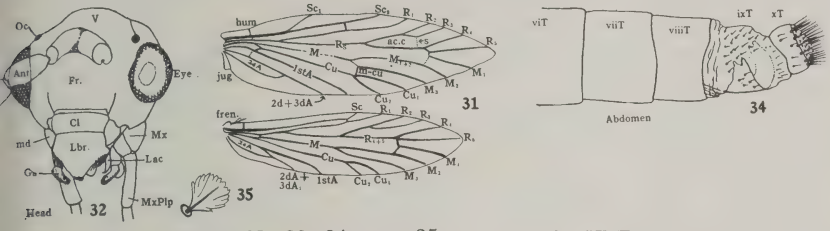
Family 1. **MICROPTERYGIDÆ**

(Eriocephalidæ)

Head broad (fig. 32); the ocelli widely separated by a bare space from the small eyes; all sutures preserved; loosely hairy, with a naked space above eyes. Antennæ moniliform, with whorls of stiff bristles, the scape and pedicel scaled. Mandibles large, functional; maxillæ with a large, folded, five-jointed palpus, without a tongue, but with a small, stiff lacinia which serves in handling food, as well as the two-jointed galea (fig. 33); labium with a well-developed basal segment, supporting the two palpi; the mouth parts as a whole exactly as in ordinary biting insects; middle tibia with a tuft of hair at tip, but without spurs; hind tibia with four spurs. Abdomen of female ending in two retractile segments, without a trace of an ovipositor (fig. 34).

Fore wing (fig. 31) bluntly lanceolate, $\mathbf{R}_5$ running to costa. **Sc**

orked shortly beyond middle, R_1 forked or connected by a cross ein to **Sc**, accessory cell present. **2d A** with large fork at base, con-



FIGS. 31, 32, 34, AND 35. MICROPTERYGIDÆ

31, Epimartyria, venation

32, Micropteryx, head: **Ant**, antenna; **Cl**, clypeus; **fr**, front; **Ga**, galea; **Lac**, acinia; **Lbr**, labrum; **md**, mandible; **Mx**, maxilla; **MxPlp**, maxillary palpus; **Oc**, cellus; **V**, vertex

34, Micropteryx, end of abdomen; **viT** to **xT**, inclusive, terga of sixth to tenth egments of abdomen

35, One of the scales representing setæ on the larva of Micropteryx (after Chapman). ×120

lected across **1st A** to **Cu** by an pparent cross vein, no distinct ein below the lower fork of **2d A**; ugum overlying hind wing. Hind ing with similar venation but ith Sc_1 lost, anal system reduced, nd no jugum.

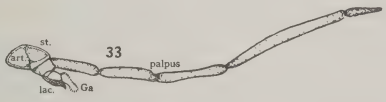


FIG. 33. MICROPTERYX. MAXILLA

Abbreviations as in figure 32; **art**, articulation; **st**, stipes

Egg spherical, apparently of the flat type; studded with blunt-ipped spines, white or yellowish; the eggs laid in small clusters in, nd under, wet moss. Caterpillar of a slug-caterpillar type, poly-gonal in cross section, exceedingly thin-skinned, and soon shriveling f allowed to dry; with two double rows of socketed scales on each ide (fig. 35), irregular on prothorax and last segments; ninth abdom-nal segment well developed. Prolegs represented by conical processes n first eight segments of abdomen, with a large sucker on the ninth nd tenth. True legs normal. Head with mouth turned forward, eye apparently single and dorsal. Antennæ longer than head, the second segment the longest. Food wet moss, the known species feeding n Hypnum and liverworts. Pupa in a dense, parchment-like cocoon, with large, crossed mandibles; not well known. Hibernation probably as larva in the cocoon.

Distribution probably world-wide; about 35 known species.

The imagoes feed freely on the pollen of various flowers, using both mandibles and maxillæ.

1. *MICROPTERYX* Hübner

(*Eriocephala* Curtis)

Characters of the family. Fore wing with R_1 simple.

Our species belongs to the subgenus Epimartyria Walsingham, with R_4 and R_5 stalked.

1. **M. auricrinella** Walsingham. Purple. Head with golden gloss; base of fore wing with golden scaling; under side and hind wing mouse gray with purple iridescence. 9 mm.

The moth may be found in partly shaded, wet places in May, and is extremely local. It is commoner northward. It is nearly invisible in flight and is most often picked up in sweeping for Diptera. Its life history is unknown. This may be a synonym of *M. luteiceps* Walker, described from Nova Scotia as a slightly larger form (6 lines = 12 mm.).

Distribution general in the northeastern States and Canada. New York: Mt. Marcy (4000 feet).

Family 2 **ERIOCRANIIDAE**

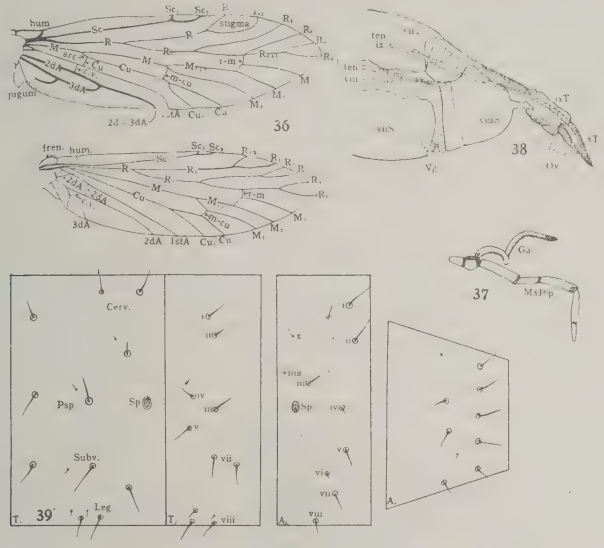
(Micropterygidæ, in part)

Head dorsally like that of the Micropterygidæ, antenna filiform, with sparse scaling on shaft; mandibles rudimentary, conical; maxillæ with long folded palpus, but with a short, spirally coiled tongue, and no lacinia (fig. 37); basal joint of labium preserved. Fore wing (fig. 36) with **Sc** shortly forked near tip, R_1 forked, accessory cell variable, R_5 running to apex, R_4 stalked, one radial sometimes absent. Anals similar to those of the Micropterygidæ, but with an additional vein below the fork of **2d A** (fig. 36). Jugum as in the Micropterygidæ. Hind wing similar to fore wing; Sc_1 rudimentary or absent, anal system quite variable (the most complex arrangement known to me is shown in figure 36). Frenulum rudimentary. Hind tibia normal, hairy; middle tibia with a single spur. Abdomen of female terminating in a horny, piercing ovipositor, with powerful muscles (fig. 38).

Egg ellipsoidal, soft, laid in the tissues of the leaf. Caterpillar of leaf-miner type (fig. 39) with large head; flattened; body-setæ much reduced, but apparently with **i** and **ii** vertically placed on abdomen, and **ia** and **ib** similarly on mesothorax and metathorax. Prolegs rudimentary, apparently present on first eight segments of abdomen; true legs absent. Ninth segment well developed. Head with mouth pointing forward, with a single ocellus on dorsal surface.

The caterpillar makes a roomy blotch mine, starting from a short, linear one, in the hardly expanded young leaves of Amentiferæ, which are sometimes distorted in their further growth. It scatters its frass loosely. It feeds quickly, in the spring, and then spins a tough cocoon in the ground and summers and winters there, pupating in the spring.

Pupa with enormous mandibles, crossed in repose, which it uses to cut its way out of the cocoon and to dig up to the surface. All parts loose (*pupa libera*), there being some power of motion even between



FIGS. 36–39. ERIOCRANIIDÆ

36, Mnemonica, venation; fore wing: **c.v.,** crossvein, **1st A** to **2d A; hind wing: c.v.,** crossvein, **2d A** to **3d A.**

37, Eriocrania, maxilla: **Ga,** galea **MxPlp,** maxillary palpus

38, Eriochania, end of abdomen: **viiT** to **ixT,** inclusive, seventh to ninth tergites of abdomen; **xT,** tenth tergite or ovipositor; **viiS, viiiS,** seventh and eighth sternites; **ten viii, ten ix,** tendons of eighth and ninth segments; **Ov,** oviduct; **Vg,** vagina

39, *Mnemonica auricyanea*: seta map (after Busck)

the thoracic segments; skin extremely thin, shrivelling on emergence. All sutures distinct; labrum large, free, with six pairs of setæ. First seven abdominal segments free.

The imagoes are short-lived, and usually do not feed. The family is apparently world-wide in distribution, with about 20 known species.

1. *ERIOCRANIA* Zeller

(*Micropteryx,* in part; *Eriocephala* Dyar, laps. cal.)

Characters of the family. Wings lanceolate. Our species belong to the subgenus **Mnemonica** Meyrick; with all veins present, accessory cell absent in both wings, and **R** of hind wing 4-branched.

1. **E. auricyanea** Walsingham. Head and thorax with long, gray hair, with slight iridescence. Fore wing golden with scattered, small, purple spots, each of several scales, the spots denser toward base and inner margin. Larger blotches along margin toward apex, and at anal angle, and a streak running up from inner margin near base. 12 mm.

Moth in March and April. Larva in a large blotch mine on oak, chestnut, and chinquapin, in April and May; extremely local, sometimes confined to a single tree.

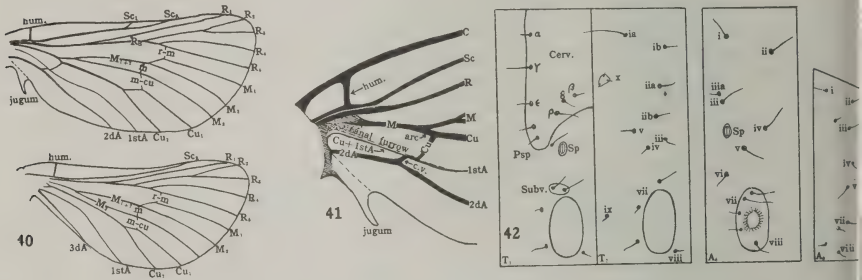
District of Columbia. New York: Karner.

2. **E. griseocapitella** Walsingham. Similar to the preceding species but without any purple blotches, the spots being all small and rounded; perhaps not distinct. Described from the District of Columbia.

Family 3. **HEPIALIDAE**

(Swifts)

Head loosely hairy over whole upper surface, concealing the rudimentary ocelli when they are present; mouth parts rudimentary, mandibles and maxillæ recognizable under the microscope, basal joint of labium present, bearing the small, hairy palpi; antennæ, in our species, about as long as width of thorax, somewhat moniliform, pedicel large



FIGS. 40–42. HEPIALIDÆ

40, *Hepialus sylvinus* (Europe), venation; **41,** same, detail of base of fore wing; **42,** *Sthenopis humuli* (Europe), seta map (after Fracker)

and scaled, but flagellum scaled at base only. Legs weak, without spurs; the hind legs of many species with a large tuft of hair in the male. Fore wings (fig. 40) with humeral vein, with **Sc** more or less distinctly forked but little beyond its middle, $\mathbf{R}_1$ simple, $\mathbf{R}_2$ and $\mathbf{R}_3$ stalked, the apex below $\mathbf{R}_3$; base of **M** fully preserved, forming a large intercalated cell. Oblique anal cross vein present, as in the Micropterygidæ (fig. 41), but anal system more or less reduced, often with only **2d A** fully developed. Jugum slender, with a long, free tip underlying hind wing in flying position. Hind wing with practically identical venation, but anal region more reduced, with simple veins. Thorax very loosely organized, leaving a distinct space between the

bases of the fore and hind wings. Abdomen long and clumsy, without any modifications; in the female ending in complicated structures not yet fully understood.

Eggs of flat type, rounded, usually scattered broadcast in the neighborhood of the food. Larva (fig. 42) a borer; slender, cylindrical, with a rather long head. Ocelli six, the four anterior not in a crescent, but in an oblong group, the other two close to them. Maxillæ of a peculiar type, the palpus with three free segments. Mesothorax and metathorax with setæ **ia** in front of **ib**, as on abdomen, **v** higher than **iii** and **iv**. Abdomen with lateral setæ high, **iv** higher than spiracle, and the three arranged in an oblique row; **iiia** and **x** well-developed setæ, but **ix** minute; ninth segment of abdomen large, with setæ normally arranged. Prolegs normal, with multiserial hooks in a complete ellipse, the upper hooks rudimentary and grading into the skin granulations. The caterpillars normally bore in roots and root-stocks, and those of Sthenopis are practically aquatic; they are very active.

Pupa slender, fitting the burrow; mandibles rudimentary, but sharply defined; all sutures of head preserved except the clypeo-labral, even the gena being distinct; antennæ short, maxillæ very short and widely divergent, quadrangular, not covering the labium, the parts not differentiated; abdomen with two series of spines on each segment, the end of the abdomen roughly spined, without a cremaster; setæ **iv** not as high as in the larva. Abdominal segments 2 to 7 of male and 2 to 6 of female free. Pupa leaving burrow on emergence.

The moths are mostly dusk-fliers, although *H. hyperboreus* flies in the daytime. The family is world-wide and largely developed in Australasia, with nearly 200 species.

Key to the genera

Fore wing with marked apex and straight or concave upper half of outer margin ..... 1. **Sthenopis.**
Fore wing with bluntly rounded apex ..... 2. **Hepialus.**

1. *STHENOPIS* Packard

(*Hepialus,* in part)

The larvæ, so far as known, bore in the roots of trees and shrubs growing partially submerged, and usually work below the water level. The moths have the habit of swarming like midges, the males having a wavy, zigzag flight, and the females apparently entering the swarm of males one by one. They are very short-lived and do not come to light or sugar. The larvæ feed at least two seasons, pupating in early summer. The pupa has a peculiar comb of short spines on the venter of the seventh segment of the abdomen, which also shows weakly in Phassus. The genus is doubtfully distinct from Phassus.

Key to species

1. Pale yellow (fading to dirty white) ..... 5. *thule*.
1. Brown with bronzy iridescence ..... 4. *auratus*.
1. Ochre yellow, or brown and gray.
  2. Hind wing salmon, brighter than the yellowish fore wing. 3. *quadriguttatus*.
  2. Hind wing straw yellow, shading into ochreous toward border. 1. *argenteomaculatus* ♀.
  2. Hind wing mouse gray.
    3. Median dark band not noticeably invading cell M_3; postmedial dark band with a clearly marked outer defining line from M_1 to below Cu_2 at least; median and apical dark areas not suffused with yellow-brown; hind wing normally shaded with ochreous at apex; lower silvery spot usually enlarged, triangular ..... 1. *argenteomaculatus* ♂.
    3. Median dark band most often with a triangular extension in cell M_3 or else not extending below M_3 at all, and usually suffused with yellow-brown; outer boundary of postmedial band distinct only below M_2; hind wing usually with rosy tinge, silver spots subequal or tending to disappear ..... 2. *purpurascens*.

1. **S. argenteomaculatus** Harris. Grayish, with darker brown, pale-edged, confused bands, the two principal bands converging from base and apex of costa toward middle of inner margin, with two shorter ones between these, and a dark marginal band. Hind wing mouse gray in male, yellowish in female, 65–100 mm (**H 41**:14).

Midsummer. Larva in rootstocks of alder.

Massachusetts to Pennsylvania and Minnesota; probably wider spread, but confused with the next two forms. New York: Catskills, Glendale, L. I.

2. **S. purpurascens** Packard. Similar to *S. argentcomaculatus* except as noted in synopsis. 75–100 mm.

Var. **los** Strecker has a single silver spot near base and one or two at end of cell; var. **perdita** Dyar is without silver (**H 41**:13).

This species is confused with the last in records. I have seen it from northern Ontario and Canada.

3. **S. quadriguttatus** Grote. Fore wing ochreous, hind wing salmon, marking exactly as in *purpurascens*, sometimes suffused. Hardly distinct from the last.

New England to northern Ontario and western New York. New York: Lancaster and Buffalo (VanDuzee), Albany.

4. **S. auratus** Grote. Grayish with a rosy tinge; bands yellow-brown, pale-margined, the submarginal and marginal often more or less completely fused, and the basal markings confused and largely fused. Angular, brassy-yellow spot at base, a discal spot, and a series of about three, subterminally. Hind wing mouse gray, tawny at margin. 50 mm.

July northward; end of June in North Carolina. Very few specimens known.

Quebec; North Carolina. New York: Fentons (Lewis County), Lancaster, Ithaca, McLean, Catskills (Summit).

5. **S. thule** Strecker. Pale yellow with obscure markings and a brown patch from base to beyond middle of costa; a couple of silvery points.

July. Sometimes common where found at all. Larva in roots of willow.

Wisconsin; Hudson Bay; Montreal; New York. New York: Waddington.

2. *HEPIALUS* Fabricius

Similar to Sthenopis; antenna full as long as thorax and less moniliform.

The moths occasionally come to light. The larvæ bore in herbaceous plant

Key to species

Yellow-brown ..... 1. *hyperboreus.*
Brownish gray ..... 2. *gracilis.*

1. **H. hyperboreus** Möschler. Yellow-brown; male with an irregular, silver **V**-mark extending across the wing or nearly so, and sometimes with silvery terminal spots. Female similar to male or with an obscure blackish **V** only. 50 mm.

The species is hardly distinct from *H. ganna* of the Alpine regions of the Old World, and the forms in this country are not well understood. The form with silvery terminal spots flies by day, and is typical *hyperboreus* (Labrador, Alberta); the one without is **macglashani** Henry Edwards (**H 41**:15) and is a dusk-flier (Ontario, California).

Hymers, Ontario; Arctic America, and westward.

2. **H. gracilis** Grote. Fore wing brownish gray, mottled, the most distinct marking being an irregular band from base to middle of inner margin, and one from apex nearly to the same point, both with a gray central shade, and often with a blackish shade where they meet. ♂ over 30 mm.; ♀ over 40 mm.

The larva is likely to bore in ferns.

Maine to Massachusetts; Colorado.

Var. **mustelinus** Packard. is a more northern form of the species dominant in Nova Scotia and Quebec, and also ranging to Colorado. It is smaller (♂ under 30, ♀ under 40 mm.) more decidedly brown, and more contrastingly marked than the type, the female being as contrastive as the male of the typical form. Intergrades are not rare.

Suborder **FRENATÆ**

(Heterocera, in part)

Aculeæ present only in a few of the most primitive forms. Ocelli, when present, close to the upper margin of the eye, placed directly behind the antennæ, but often absent. Antennæ with sense-cones except in a few primitive forms, the second segment, or pedicel, usually proportionately small. Vertex separated by sutures in the lower forms; in the higher ones with practically all the head-sutures obliterated. Mouth parts never of the mandibulate type, when not rudimentary with the labrum three-lobed, the central lobe filling the gap between the bases of the two maxillæ, the lateral lobes forming the pilifers. Maxillæ with basal structures reduced; the lacinia absent, and the palpi in the majority of forms reduced or absent. Labium usually rudimentary or absent, except for its three-jointed palpi. Thorax with the third segment smaller than in the Jugatæ, often reduced dorsally to a narrow strip, but always developed ventrally for the attachment of the legs; the two halves of the scutum usually widely separated. Abdomen in primitive forms (Adelidæ) with a horny, piercing ovipositor (fig. 50), which becomes lost in the higher types, though the two pairs of strong tendons and muscles are preserved. In many of these higher forms the ovipositor ends in two lobes.

Fore wing with humeral vein rudimentary or absent; **Sc** always simple; $\mathbf{R}_1$ always simple, base of media and **1st A** often lost, **2d A** always preserved, and usually apparently forked at the base, as a result of the attachment to it of the tip of the upper fork of **3d A**; lower fork of **3d A** usually lost; (sometimes the lower fork is free, or **3d A** wholly lost). Jugum never present, the inner-marginal cord always running directly into the scutellum. (In the nonaculeate forms, there is a small patch of minute spines on the inner margin near the base, which may be a persisting remnant of the aculeæ). Hind wing with the radius much reduced, typically with only one free branch (**Rs**, usually spoken of merely as **R**); **Rs** once forked in the lower Elachistidæ, and in our genus Tinagma, in which latter genus the dorsal venation is much reduced; $\mathbf{R}_1$ crossing over to **Sc** and fused with it from its junction to the apex, except in a few Gracilariidæ with very narrow wings; if **Sc** and **Rs** remain separate, $\mathbf{R}_1$ looking like a crossvein, usually located near the base of the wing in those forms where **Sc** and $\mathbf{R}_s$ remain independent, but often obliterated by the fusion of **Sc** and **R** at the point where $\mathbf{R}_1$ should cross. Hind wing usually with three apparent anals, or two by the loss of **1st A**; for the upper fork of **3d A** has become almost completely fused with **2d A**, in the Tortricidæ and broad-winged Tineids (in the broad sense), showing as a distinct basal fork of **2d A**, as on the fore wing. Cross-

veins between the anals very rarely present but obvious in a few Cossidæ and Psychidæ between **1st A** and **2d A** of the fore wing, and visible at the base of the wing in a few low Tineids. Secondary veins rare, present on the inner margin of the fore wing of the Megalopygidæ, and near the base of the costa of the hind wing of most Lasiocampidæ (fig. 428), where they are known as humerals, one of them, perhaps, being the true humeral. Humeral vein often present; when the frenulum is present usually running across to its base. Costal edge thickened out to the point of origin of the frenulum, being a rudiment of vein **C**. Frenulum lost in several of the higher families, either in part or all of the genera; when present, it is practically always single, in the male, running through a membranous retinaculum attached just below the costal edge of the fore wing; in the female, however, usually multiple, formed of two to many bristles, and held in place by stiff hair-scales projecting down from **Sc** and **R**, and up from below **Cu** of the fore wing. Frenulum occasionally single in the female also.

Caterpillar with the setæ **ia** and **ib** of the thorax vertically placed, on the abdomen with **i** anterior to **ii**; thorax normally with **v** lower than **iii** and **iv**; abdomen with **iv** level with the spiracle or lower, and **iv, v,** and **vi** not lying in an oblique line; **iiia** and **x** minute; prolegs rarely either modified or absent; body often with tufted or secondary setæ. Maxillary palpus with only two free segments; four anterior ocelli, when present, arranged in a semicircle. When only a single ocellus occurs, it is on the side of the face.

In boring larvæ, the structures are usually normal; but leaf-miners may be exceptions to most of the characters given in this definition.

Pupa with head-sclerites more or less completely fused; metathorax smaller than in Jugatæ and thoracic segments never free, but in other particulars varying from forms with almost the structure of the Jugatæ, to forms with all the parts soldered together.

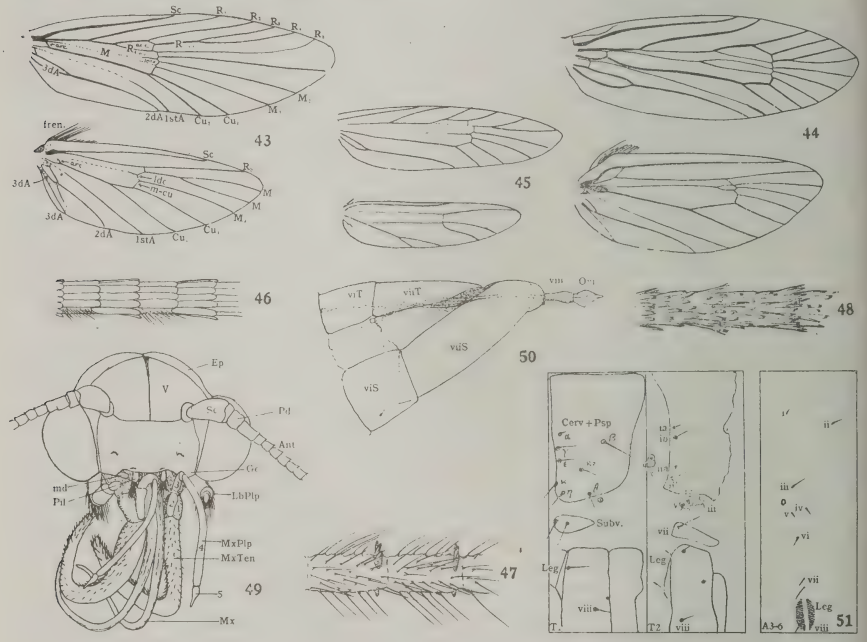
The Frenatæ have been derived from a Jugate type intermediate between the three surviving families; the Rhopalocera are derived from primitive Frenatæ in the neighborhood of the Cossidæ, as is indicated by a series of intermediate exotic forms.

SUPERFAMILY **INCURVARIOIDEA**

Family 4. **INCURVARIIDÆ**

(Adelidæ)

Vertex very rough-haired, front either rough or scaled; with a distinct naked area above eye behind antennæ, except when the eyes are very large. Vestiture lightly attached. Eyes extremely variable



FIGS. 43–51. INCURVARIIDÆ

43, *Adela ridingsella,* venation
44, *Prodoxus decipiens,* venation
45, *Eudarcia simulatricella,* venation
46, *Adela ridingsella,* ♀; section of antenna, ventrolateral view
47, *Incurvaria,* antenna
48, *Paraclemensia,* antenna
49, *Tegeticula yuccasella,* ♀, head: **Ant,** antenna; **Ep,** epicranium; **Ge,** gena; **LbPlp,** labial palpus; **Mx,** maxilla (tongue); **MxPlp,** maxillary palpus; **MxTen,** maxillary tentacle; **Pd,** pedicel of antenna; **Pil,** pilifer; **Sc,** scape of antenna; **V,** vertex; (the segments of the maxillary palpus are numbered **1** to **5**)
50, *Tegeticula yuccasella,* ♀, end of abdomen: abbreviations as in figure 38
51, *Adela cuprella* (Europe), seta map

in size; in some western and exotic species nearly meeting on vertex, with two sizes of facets in male. Antennæ in some genera short, in Adela the longest known in the Lepidoptera, several times as long as fore wings; often shorter in female, and more densely scaled; commonly with two equal whorls to a segment, or irregularly scaled and bristled (figs. 46–48); maxillary palpi long and folded, short and porrect, or rudimentary,—in Prodoxinæ the longest known in the Lepidoptera; tongue scaled at base. Palpi and hind tibiæ often densely hairy, especially in male. Fore wing with complete venation or a single vein lost, cell large, accessory cell and base of **M** usually distinct, **1st A** distinct at margin, **2d A** forked at base. Membrane aculeate over the whole surface of the wing. Hind wing with **Sc** swollen at base, $\mathbf{R}_1$ normally forming a heavy basal fork of it, though completely fused in Adela; base of **Rs** obsolete, **R** and $\mathbf{M}_1$ stalked only in Nemotois, **3d** $\mathbf{A}_1$ occasionally free at tip (fig. 43); scaling often hair-like, and iridescent or metallic in many species. Female, so far as known, with last segments heavily chitinized, with strong, piercing ovipositor; laying its eggs in the tissues of the food-plant.

Caterpillars, so far as known in the Adelinæ, case-bearers; the case typically lenticular and formed of a piece of leaf; borers in seeds and stems of Yucca and related Liliaceæ, in the Prodoxinæ. Head normal in form, the adfrontals reaching the vertex, the front about two-thirds way, setæ as a rule obscure; **iv** and **v** rather close together, and **iv** sometimes migrating far up behind spiracle, as in the Hepialidæ. Prolegs normally with two areas of granulations bearing rudimentary hooks, with a single line on sixth segment of abdomen, and no anal prolegs; prolegs reduced to one or two rows of minute hooks in Incurvaria, and all lost in the Prodoxinæ; true legs also lost in Prodoxus.

Pupa incomplete, chitinized, with a frontal beak; thorax, appendages and terminal segments only lightly soldered; third segment of abdomen free; dorsal spines in a patch or pair of patches on each segment, sometimes supplemented by a row of spines; maxillary palpi distinct, extending from antennæ to base of maxillæ; prothorax very narrow and more or less depressed; dorsal head piece conspicuously widened (the "Adelid prothorax"). A few Incurvarias (of group Lampronia) have only the series of spines on abdomen, and many genera are still unknown in the early stages.

This is a small and ancient world-wide family containing two or three hundred known species. The genera Triptodema, Mea, and Pelates have not been examined for aculeæ or ovipositor, and so are tentatively allowed to remain in the Tineidæ; in several other genera

the ovipositor has not been examined. The genera of this family are repeated in the key to the Tineidæ for convenience in identification.

Key to the genera

1. Antennæ at least a fourth longer than fore wings.
  2. R and M_1 of hind wing stalked.....8. **Nemotois.**
  2. M_1 free from R, sometimes closely associated with M_2.....7. **Adela.**
1. Antennæ hardly if at all longer than fore wings.
  2. Maxillary palpi very short and porrect, or absent.
    3. Tongue strong, labial palpi moderate.....7. **Adela.**
    3. Tongue obsolete, labial palpi minute.....4. **Chalceopla.**
  2. Maxillary palpi well developed, folded, usually covering base of tongue.
    3. Folded part or maxillary palpus two-thirds as long as width of head.
      4. Females (with exserted ovipositor).
        5. Maxilla with a long, thick, naked, coiled tentacle besides palpus and tongue .....2. **Tegeticula.**
        5. Maxilla with a sharp angle on second joint of maxillary palpus only. 1. **Prodoxus.**
      4. Males, (with large claspers).
        5. Valve one-fourth as long as fore wing.....1. **Prodoxus.**
        5. Valve less than one-sixth as long as fore wing.....2. **Tegeticula.**
    3. Folded part of maxillary palpus half as long as width of head.
      4. Venation complete .....3. **Incurvaria.**
      4. Fore wing with a vein lost.
        5. Hind wing with 7 veins, lanceolate, with open cell.....6. **Eudarcia.**
        5. Hind wing broader, with complete, normal venation...5. **Paraclemensia.**

1. *PRODOXUS* Riley

Similar to Tegeticula, male with larger valves; female with only a rudiment of the maxillary tentacle. Caterpillars boring in Yucca, our species in *Y. filamentosa*; much like Pronuba but without thoracic legs or projections representing the abdominal legs. Pupa fairly smooth, with spine-patches, and an anterior, toothed ridge on each segment. Pupa transforming in a silk cocoon at the mouth of its burrow (fig. 44).

1. **P. quinquepunctella** Chambers. Cream white, typically with about five black points, but in var. **decipiens** Riley immaculate. 15–20 mm. (H. p. 438 f. 255–259.)

Common. The caterpillar bores in the flesh of the fruit and fruit-stalk of *Y. filamentosa*, emerging a little earlier than *Tegeticula yuccasella*.

Central New Jersey to Missouri and south.

2. *TEGETICULA* Zeller

(*Pronuba* Riley 1872, not Thomson 1860; *Valentinia* Coolidge 1909, not Walsingham 1909)

Antennæ smoothly scaled, the scaling not regularly formed of two whorls to a segment; scales easily lost, uncovering the fine, chitinous spinules; palpi rather small and slender, upturned, with scales and bristles, the basal segment decidedly the longest; maxillary palpi folded, five-jointed, the first joint very long; vertex roughly hairy. The female with a long, roughly spinulose, coiled tentacle growing out from the junction of the first and second joints of the max-

illary palpus (fig. 49). Fore wing with normal primitive venation, with base of M and R_{4+5} preserved, veins all arising separately from the cell, or one or two shortly stalked.

Egg laid in the tissues of the ovary of a Yucca flower, larva feeding on the developing seeds, but only damaging part of those in the capsule. Head not depressed, small; front triangular, separated from the vertex by the adfrontals; body stout, somewhat fusiform, strongly tapering behind, not flattened; with small thoracic legs, the prolegs on the third to sixth abdominal segments represented by fleshy humps, but without crochets. Pupa with a strong frontal spine, with a heavy, serrated ridge on each segment of abdomen, with very stout, subdorsal hooks on eighth segment of abdomen pointing forward, but no cremaster.

The moth uses its tentacles to gather and carry a ball of pollen. After laying each egg the moth inserts one of the tentacles into the ovary of the flower through the stigma, and fertilizes the ovules with it.

1. **T. yuccasella** Riley, (Yucca borer). White, immaculate, usually with gray hind wings. 20–25 mm. (H. p. 442, f. 262–263.)

The moth is common where Yucca is found, emerging during the flowering period in May and June. Larva in *Y. filamentosa.*

New York to Ohio, Missouri, and south. New York: Long Island.

3. *INCURVARIA* Haworth

(*Lampronia* Stephens; *Tinea,* in part)

Similar to Prodoxus, but with smaller maxillary palpi, and, in our species, black, or dark metallic blue in color. Typically with whole head rough-hairy, but in group **Lampronia** with the face smooth and head sometimes not very rough. Male antennæ pectinate in some exotic species. The characters are superficially much like Tinea, but the scaling of the antennæ is smooth, and less regularly arranged in two rows to a segment (fig. 47); if the scales are rubbed off, the underlying spinules show, the antenna in either case appearing smooth and velvety to a low-power lens, and commonly bristly under higher power.

Larvæ sometimes borers in stems, like Prodoxus, sometimes leaf-miners when young, and later cutting out a flat, lenticular case. Head as in Tegeticula, body smoother, prolegs with one or two transverse rows of minute hooks, setæ iv and v rather close together, below and behind spiracle. Pupa apparently like Prodoxus, with dorso-anal spines.

Key to the species

1. Straight, antemedial fascia, no costo-apical spot.....1. *russatella.*
1. An irregular, pale spot on costa before apex, besides the one three-fourths way out.
2. Head dull white, antemedial fascia complete.....3. *aureovirens.*
2. Head pale straw yellow, antemedial fascia angulate, or not reaching costa. 2. *taylorella.*

1. **I. russatella** Clemens. Deep brown; head ochreous, with rough face; antennæ annulate, purple and gold; a pale golden fascia a fourth way out on fore wing, slightly wider at inner margin, not always reaching costa; costal and dorsal spots at middle and traces of a pale costal subterminal spot. Apical fringe white-tipped. 13 mm.

Apparently not common. May; July.

Both wings are normally scaled.

Canada to Pennsylvania and District of Columbia. New York: Ithaca.

2. **I. taylorella** Kearfott. Head pale straw yellow, darker above; antennæ annulate, pale straw and brown; fore wing with fascia extending up from inner

margin, typically not reaching costa, but if so, narrow and angulate; spot beyond middle of costa very large, and rather beyond the corresponding dorsal spot; subterminal spot sending a spur down in dorsal fringe almost to anal angle. 18 mm.

May; July. The structure is as in *russatella*, and the species is near *capitella* of Europe, which bores in the stem of Ribes. It is doubtfully distinct from *I. russatella* and occurs with it at New Brighton, Pennsylvania.

Mt. Washington, New Hampshire; Ottawa, Ontario; British Columbia. New York: Newcomb.

3. **I. aureovirens** Dietz. Hind wing narrower than fore wing, ovate-lanceolate, with hair-scaling. Markings about like *I. taylorella*. 6. mm.

Pennsylvania. This species is unknown to me.

I. labradorella Clemens, with fuscous head and markings much like *russatella*, belongs here doubtfully; the type only is known, from Labrador.

4. *CHALCEOPLA* Braun

(*Cyanauges* Braun, not Gorham; *Incurvaria; Tineola,* in part)

Head very hairy, labial palpi minute, drooping, not extending beyond the front; tongue and maxillary palpi obsolete. Venation as in Incurvaria; fore wing (in the eastern species) overlaid with golden hair-scales.

Key to the species

Ground purple ..... 1. *dietziella.*
Ground blue-green ..... 2. *cyanella.*

1. **C. dietziella** Kearfott. Face very rough; M_1 and M_2 stalked in hind wing. Fore wing when fresh with golden hair-scales mixed with the normal scales. Head old gold; body and antennæ fuscous; fore wing with the normal scales purple with golden bases, which are exposed in rubbed specimens. Hind wing slightly brower. 9 mm. (*Incurvaria, Tineola.*)

June. The larva possibly on Cornus.

Essex Co., New Jersey.

2. **C. cyanella** Busck. M_1 and M_2 free. Head brilliant orange-ochre, the antennæ contrasting, blackish; body and fore wings deep metallic green, the hair-scales golden; hind wings purple. (*Incurvaria* Busck.)

Alleghany Co., Pennsylvania; Cincinnati, Ohio; doubtfully from Maryland.

5. *PARACLEMENSIA* Dyar

(*Brackenridgia* Busck 1903, not *Aldrich* 1902; *Incurvaria,* in part)

Similar to Incurvaria, with narrow sparse scaling on the lanceolate hind wing. M_2 of fore wing lost, M_1 and M_2 of hind wing short-stalked. Antennæ irregularly scaled (fig. 48). Larva at first a leaf-miner, later in a lenticular case, eating crescentic paths in the tissue of the leaves. (Fig. 48.)

1. **P. acerifoliella** Fitch. Under-scaling deep purple-blue, densely overlaid with peacock green; hind wing pale, translucent. Head orange, antennæ black. 9 mm. (*iridella* Chambers; *Ornix* Fitch).

Larva (Maple case-bearer) on maple (normally only on rock maple); and more rarely birch, oak, beech, and huckleberry (Braun); occasionally in injurious numbers.

Massachusetts to British Columbia. New York: St. Lawrence County, generally; Black Brook (Clinton Co.), Ithaca, McLean, Albany, Bolton (Felt), Deposit.

6. *EUDARCIA* Clemens

(*Meessia* Spuler)

Face exceptionally rough; eyes extremely small, but prominent and visible from above, behind the antennæ, which are longer than fore wing. Fore wing (fig. 45) with one medial lost; closing vein of accessory cell weak and arising before end of discal cell, making R_2 and R_3 appear stalked together; hind wing two-thirds as wide as fore wing, with broad fringe; one medial lost, cell open above **Cu** and base of media preserved.

The larva lives in a flat, ovoid, rough case, on lichens. *E. simulatricella* is closely related to *E. vinculella* of Europe.

1. **E. simulatricella** Clemens. Blackish; head ochreous. Fore wing with a fascia a third way out, costal and dorsal spots opposite each other at middle, an apical spot, not reaching either margin, and extreme tip of fringe white. 9 mm. (*bipunctella* Walsingham).

Pennsylvania.

2. **E. cæmitariella** Chambers. Similar to *E. simulatricella*, no white in fringe, markings generally much narrower and more oblique. 9 mm.

In the type specimen the fascia is broken; there are three median spots, the middle one farther out and obscure, and two white spots beyond, on costa.

This species has been confused with the similarly marked *Ornix guttea*, but the type is undoubtedly Adelid. I have seen no other specimens.

Kentucky; Gulf States.

7. *ADELA* Latreille

Antennæ (fig. 46) at least as long as fore wings, almost always several times as long in male, but relatively short and roughly scaled toward base in most females; with large basal joint. Eyes varying from very small to very large, larger in male; tongue strong, scaled at base; maxillary palpi minute, porrect; labial palpi bristly; vertex with long, bristly hair, front variable. Hind tibiæ in several species heavily bristled. Ovipositor of female strong, simpler than in Tegeticula. Fore wings (fig. 43) with all ten veins arising from the cell, preserved, R_5 running to costa; all veins free, or R_3 and R_4 shortly stalked; hind wings with all veins free, or M_1 and M_2 connate or stalked; **Sc** much swollen at base, R_1 not recognizable.

The larvæ (fig. 51), when young, live, as a rule, in flowers or seeds; when older, they form a lenticular case of two, flat, oval pieces of leaf, in which they pupate. Their prolegs are extremely primitive, each consisting of two areas of hooks, grading off into the normal skin-granulations, and separated by a narrow fold of membrane. The leg on the sixth segment of the abdomen is reduced, and there is none on the anal segment. The pupa is normal.

Key to the species

A patch of black spots near anal angle (speculum) ..... 1. *ridingsella.*
No speculum.
  A white postmedian fascia ..... 2. *purpura.*
  Immaculate blue ..... 3. *bella.*

1. **A. ridingsella** Clemens. Antennæ relatively short (in male twice as long as fore wing, and one and one-fourth times in female); face hairy, palpi moderate, eyes small; fore wing with R_3 and R_4 stalked, hind wing with M_1 and M_2 stalked. Head dark, antennæ annulated with white, fore wing yellow-brown, with a pale grayish patch beyond middle, covered with rows of black dots; with a silvery

fascia before its middle, and shorter ones beyond it near margins; speculum of about 6 black patches with silver scales between them. 13 mm. (*schlægeri* Zeller; *Dicte coruscofasciella* Chambers).

June, July.

Maine to mountains of North Carolina; northern Pennsylvania. New York: Rock City (Cattaraugus Co.), Ithaca.

2. **A. purpura** Walker. Antennæ in male three times as long as fore wing; face hairy, palpi very bushy, eyes of moderate size; all veins widely separate in fore wing, M_1 and M_2 stalked in hind wing. Greenish to purplish bronzy with a white medial fascia, and a costal bar beyond the fascia, both edged with black. 14 mm. (*biviella* Zeller).

The moth is found on willow bloom in April.

Nova Scotia to northern New Jersey and Manitoba. New York: Cranberry Creek.

3. **A. bella** Chambers. Antennæ four times as long as fore wing in male; one and one-half times as long and thickened with scales toward base in female; face smoothly scaled, strongly oblique inward to mouth; eyes small, palpi small and weakly bristled; hind tibia smooth. Venation as in *A. purpura*. Purple-green with lines of brighter, blue-purple iridescence toward apex. Antennæ black, with outer half white. 14 mm. (*chalybeis* Zeller; *oichroa* Zeller).

This species may be the same as *A. cæruleella* Walker.

Southern New Jersey, and southern Ohio to Texas. New York: Crugers.

8. *NEMOTOIS* Hübner

(*Adela*, in part)

Similar to Adela in all stages; eyes typically very large in male, though small in our species; **R** and M_1 of hind wing stalked.

1. **N. bellella** Walker. Male antennæ over twice as long as fore wings; female short and thickened with black scales on the basal half. Fore wing dull, old gold, striate with purple on veins, the inner margin and apex solidly purple; a broad, golden fascia two-thirds way out, and a streak in base of fold. 16 mm.

Canada; Colorado.

SUPERFAMILY NEPTICULOIDEA

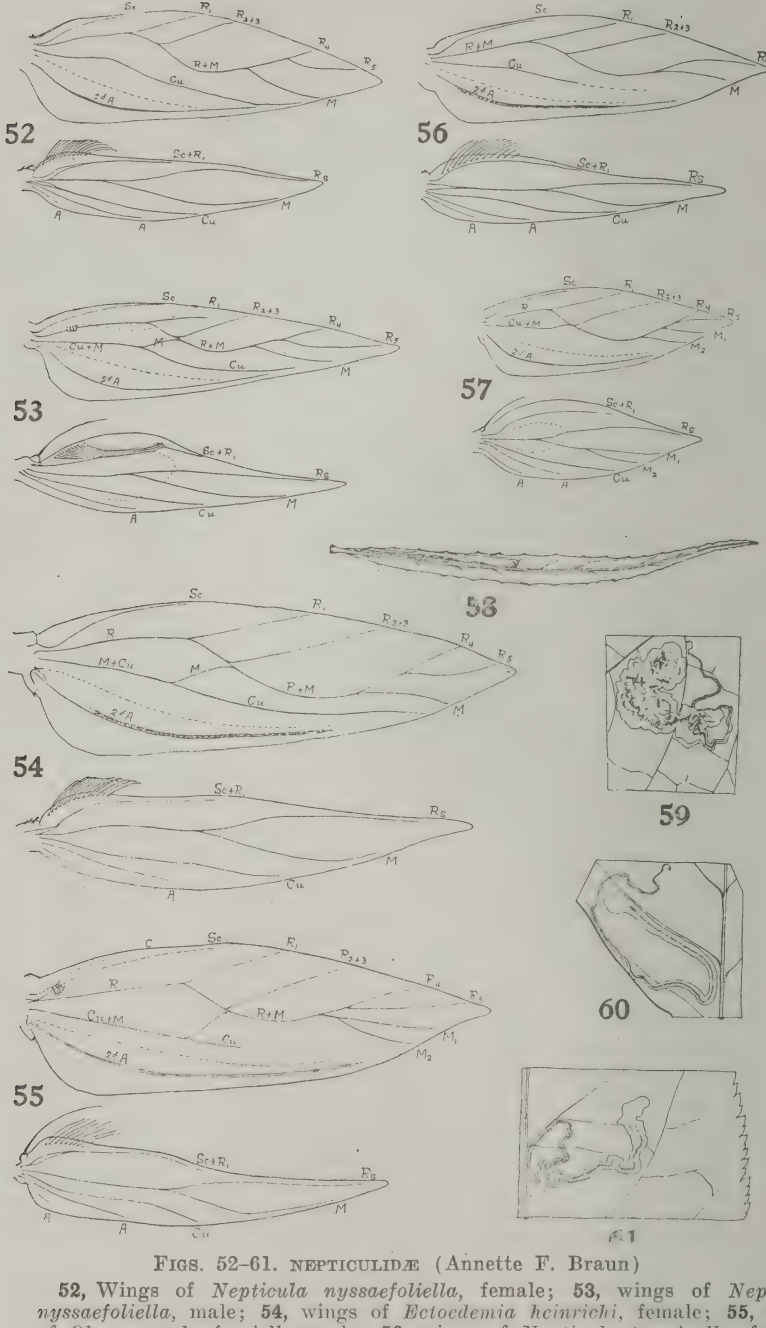
Family 5. NEPTICULIDÆ

Annette F. Braun

Head and face tufted. Antennæ not exceeding three-fourths of wing length, rather thick, with basal segment enlarged and concave beneath to form an eye-cap. Labial palpi short, porrect or drooping. Maxillary palpi long, filiform, folded. Tongue rudimentary. Posterior tibiae with bristles above. Wing membrane aculeate. *Fore wings* (fig. 52) with media coalescing with radius from base to beyond middle of wing, so that all the branches of radius and media appear to arise from one stem; or coalescing with cubitus for a short distance from base, then, either passing obliquely outward to radius just beyond $\mathbf{R}_{2+3}$, and anastomosing with radius to beyond middle of wing, as before, or remaining separate from radius, in which case (Trifurcula) $\mathbf{R}_{4+5}$ is absent. $\mathbf{R}_{2+3}$ coincident. $\mathbf{R}_{4+5}$ separating beyond **M**, or coalescing to apex. Cubitus unbranched, sometimes coincident with **M** or becoming obsolete beyond its point of separation from **M**. Second anal vein very prominent. Crossveins absent. A fibula (jugum) present in females of the more primitive genera. *Hind wings* (fig. 52) with subcosta and $\mathbf{R}_1$ coincident; **Rs** and **M** coalescing to about the middle of the wing. Media one- or two-branched. Cubitus unbranched. No crossveins. Frenulum of male consisting of a single strong spine; of female, rudimentary, of several minute spines. The function of the frenulum is performed, in the female, by a series of curved spines along base of costa. Hind wing one-half to almost as broad as the fore wing.

The moths, because of their minute size and retired habits, and very rapid and irregular flight, are not frequently seen. Early in the spring, some species may be collected resting in the crevices of bark. Later, moths may sometimes be found on leaves, usually those of their food plants. Occasionally, because of the peculiarity of all the individuals of a single generation maturing and emerging at the same time, great numbers of moths may be seen on leaves of the food plant and neighboring plants. To secure an adequate representation of the group, however, rearing of the moths from larvæ is necessary.

With the exception of several gall-making species of Ectœdemia, the larvæ of all species of which the life history is known, are miners within the tissues of leaves or in bark (rarely in fruits). They show a preference for trees and shrubs, but not a few mine leaves of herbaceous plants. When full grown, the larva, with few exceptions, leaves the mine, and, dropping to the ground, spins a dense, flattened cocoon amongst the rubbish or in the loose surface soil.



FIGS. 52–61. NEPTICULIDÆ (Annette F. Braun)

52, Wings of *Nepticula nyssaefoliella,* female; **53,** wings of *Nepticula nyssaefoliella,* male; **54,** wings of *Ectocdemia heinrichi,* female; **55,** wings of *Obrussa ochrefasciella,* male; **56,** wings of *Nepticula terminella,* female; **57,** wings of *Glaucolepis saccharella,* male; **58,** mine of *Nepticula pallida;* **59,** mine of *Nepticula nyssaefoliella;* **60,** mine of *Nepticula saginella;* **61,** mine of *Nepticula pomivorella*

The egg is a minute oval body attached to the surface of the leaf or bark by a minute, glistening speck of cement, which renders its location visible even to the naked eye.

The larva of Nepticula upon hatching eats directly into the leaf, and makes a very narrow, linear mine (figs. 58 to 61), which is at first often difficult to discern, since in its early stages, the larva consumes but a small part of the leaf tissue. This mine may continue as a linear mine, gradually broadening throughout its course, or it may at some period abruptly enlarge into a blotch. In the latter parts the mine is semitransparent and easily visible. The mine of any one species is very constant and characteristic in appearance, and, in most instances, serves for immediate identification of the species. The species of Ectœdemia are gall-producers or bark-miners in forest trees.

The larva is slightly flattened, with the head deeply retracted into the prothorax, due to the lengthening of the dorsal side of the head. Locomotor organs are represented by mere roughened protuberances; such rudimentary feet are present on segments three and four, on segments six to eleven, inclusive, and sometimes on the last segment in Nepticula; in Ectœdemia there are sometimes one or two additional pairs of rudimentary processes.

The cocoon is spun of dense brown or yellowish silk, flattened oval in general outline, but usually broader at its anterior end, around which a fissure extends, guarded by the smooth projecting edges of the two halves of the cocoon. Through this fissure the pupa is thrust at emergence. In some species, the flat, projecting edges form a rim extending entirely around the cocoon.

The pupa is flattened ovate; all the appendages are free and segmented; and segments one to seven inclusive of the abdomen are free. The pupa shows in some respects a resemblance to that of the primitive Eriocraniidae.

The moth is active almost immediately after emergence, running rapidly up and down the sides of the breeding jar, and in an incredibly short time has the full use of its wings. When at rest, the wings lie almost horizontal, meeting in a line down the middle of the back.

Key to the genera

(European genera in brackets)

A. R_5 of fore wing present.
  B. Media of fore wing with three branches (Scoliaula).
  BB. Media of fore wing with one or two branches.
    C. Media of fore wing two-branched.
      D. Media of hind wing two-branched.....1. **Glaucolepis.**
      DD. Media of hind wing single-branched.....2. **Obrussa.**
    CC. Media of fore wing single-branched.
      D. Middle spurs of posterior tibiæ in or above the middle....4. **Nepticula.**
      DD. Middle spurs of posterior tibiæ below the middle.....3. **Ectœdemia.**

1. *GLAUCOLEPIS* Braun

Eye-cap large. Middle spurs of posterior tibiæ in the middle. Fore wings elongate ovate; hind wings nearly equaling the fore wings in breadth, in the male; three-fourths of the width of the fore wing in the female. Fore wings (fig. 57); cubitus coincident with media, which anastomoses with radius from R_{2+3} to beyond middle of wing; M_3 absent; M_2 arising before separation of **M** and **R**. Hind wings: media two-branched.

1. **G. saccharella** Braun. Tuft brownish ocherous, eye-caps bluish white. Thorax and basal fourth of fore wing blue or purple metallic; remainder of wing black with a broad, bluish silvery fascia just beyond middle; cilia pale bluish. Hind wings of male with oval, yellow patch of *androconia*. 4 mm.

Very long serpentine mines in leaves of maples.

2. *OBRUSSA* Braun

Eye-cap large. Labial palpi well developed. Middle spurs of the posterior tibiæ above the middle. Fore wings elongate ovate, with fibula in the female; hind wings a little over one-half the breath of the fore wings. Fore wings (fig. 55); media coalescing with cubitus at base, then passing obliquely to radius beyond R_{2+3}, and anastomosing with radius to beyond middle of wing. R_4 separate. M_1 and M_2 coalescing for a short distance beyond separation of **M** and **R**. M_3 absent. Cubitus becoming obsolete beyond its separation from **M**. Hind wings: media single-branched.

Represented by a single species whose early stages are entirely unknown.

1. **O. ochrefasciella** Chambers. Tuft ochraceous; eye-caps buff. Fore wing blackish brown with a pale ocherous fascia at basal third; scattered ocherous scales at two-thirds, forming indistinct transverse line in female. Last row of scales at apex and cilia pale ocherous. Underside of wing of male with androconia. 6.5–8 mm.

3. *ECTŒDEMIA* Busck

Basal segment of antennae enlarged and concave beneath to form an eye-cap. Labial palpi somewhat longer than in Nepticula. Middle spurs of posterior tibiae below the middle. Fore wings elongate ovate, pointed; fibula present in the female; hind wings two-thirds to three-fourths as wide as fore wings; nearly as long as the fore wings. Fore wings (fig. 54); media coalescing with cubitus at base, then passing obliquely to radius beyond R_{2+3}, and anastomosing with radius to beyond middle of wing. R_4 separate. Media single-branched. Cubitus reaching margin. Hind wings: media single-branched.

The position of the middle spurs on the posterior tibiae, the relatively smaller eye-caps, and the broader wings will distinguish this genus from those species of Nepticula which have identical venation.

The larvæ of the species whose life history is known form galls on twigs or petioles, or are miners in the bark of twigs. The egg is somewhat more circular in outline than that of Nepticula. There is but a single generation of the moths a year, as would be expected from the peculiarities of the life history.

In all but the unicolorous *E. populella*, the fore wings are mottled with fuscous scales, or with dark-tipped scales. Ill-defined markings are formed by the grouping of these dark scales in patches. The markings differ from those species of Nepticula which resemble Ectœdemia most in structural characters.

Key to species

a. Fore wings unicolorous.....1. *populella.*
aa. Fore wings mottled.
b. Dark-tipped scales evenly distributed.....2. *castaneæ.*
bb. Dark-tipped scales more or less collected into patches.
c. Base of fore wing with scattered dusting, except near costa..5. *obrutella.*
cc. Dusting dense near base of wing.
d. A poorly defined, pale fascia at basal third.....4. *heinrichi.*
dd. No fascia at basal third.....3. *phleophaga.*

1. **E. populella** Busck. Tuft reddish ocherous, eye-caps pale yellowish. Fore wings shining coppery brown, with green and violet iridescence. 7–8.5 mm.

The larvæ form almost globular galls, of the size of a pea, on the petioles of leaves of poplar. The larva is full-grown in October. The moth appears in May.

2. **E. castaneæ** Busck. Tuft black above; eye-caps creamy-white. Fore wing clothed with bluish white scales, which are mostly deeply tipped with blackish brown, so that the wing is almost uniformily densely dusted. 7.5–8 mm.

The larvae form cylindrical galls encircling young twigs of chestnut.

3. **E. phleophaga** Busck. Tuft ocherous. Thorax and basal half of fore wing dark bluish fuscous, outer half paler, bluish with dark-tipped scales; an ill-defined, ocherous costal and an opposite dorsal patch at apical third. 9–10 mm.

Serpentine mines in bark of chestnut; larva full grown in April and May; imago in September.

4. **E. heinrichi** Busck. Tuft black, eye-caps creamy-white. Fore wing pale ocherous, densely dusted with blackish fuscous scales, which tend to form patches. The dark dusting is usually absent or scattered at the extreme base of wing except along costa and on two poorly defined, transverse fasciae, one at basal third, the other at apical third; the second fascia sometimes almost obliterated by dusting. 9-10 mm.

The larva forms a characteristic, flattened-oval, spiral mine in the bark of young branches of pin oak (*Quercus palustris*). The larvæ are full-grown in October and early November, producing moths in May and June of the following year.

5. **E. obrutella** Zeller. Differs from the two preceding species chiefly by the scattered dusting of the basal half of wing. Food plant unknown, thus far recorded only from Texas.

4. *NEPTICULA* von Heyden

Basal segment of antennæ dilated and concave beneath to form a large eye-cap. Middle spurs of posterior tibiæ in or above the middle. Fore wings elongate ovate, pointed; hind wings one-half to two-thirds as wide as fore wings. Fore wings (figs. 52, 53, 56); media coalescing with radius from base to beyond middle of wing, or coalescing with cubitus at base and passing obliquely to radius beyond R_{2+3} and anastomosing with radius to beyond middle of wing as before. R_4 sometimes coincident with R_5. Media single-branched. Cubitus usually reaching nearly to margin. Hind wings: media single-branched.

As far as is known, the larvæ of all of the North American species are miners within the tissues of leaves. The egg is placed on either the upper or under surface of the leaf, often along the side of a vein, and the larva passes directly into the interior of the leaf. The larva usually mines just beneath the upper epidermis, consuming the palisade layer of cells, and in later stages, some of the spongy parenchyma cells. In thin leaves, the mine seems more transparent, because of the originally smaller number of these cells and the looseness of their arrangement. Where the upper or lower surface is mined indiscriminately, as is done by *N. populetorum* in the leaves of poplar, the cross section of the leaf shows palisade

cells on either side. Some species mine different sides of the leaf at different periods of larval life. The mine may be a linear tract, gradually increasing in breadth to its end, or it may at some point suddenly enlarge into a blotch. A change in the character of the mine usually indicates the beginning of a new instar. There are four larval instars. The mine formed during the first instar is very short, rarely exceeding a few millimeters in length. The large, conspicuous part is made during the last larval instar, in the few days preceding the escape of the larva from the mine. The larva leaves the mine by a semi-circular slit in the upper or the lower epidermis and spins the characteristic cocoon, usually brownish, but occasionally yellowish or whitish, in the surface soil or amongst rubbish, often near the base of the tree; occasionally it spins on the twigs or branches. Pupation does not take place immediately; in the summer generations it occurs a few days before emergence, in the overwintering generation it may be delayed until spring.

A few species have but one generation a year; most species have two or three; a few of the oak-feeding species may have as many as four generations. The length of the life cycle is approximately six weeks, except in the single-generation species, where several months may elapse between oviposition and the attainment of full growth by the larva. The moths from the over-wintering generation of larvæ emerge in May and June, a few species, however, appearing in April.

Key to the species

a. Fore wings with pale spots or fasciæ.
  b. A silvery or pale golden metallic spot at, or very near, the base of the wing.
    c. A median fascia.
      d. A costal and a dorsal spot at three-fourths.....3. *pteliaecella.*
      dd. No such spots at three-fourths.
        e. Thorax and extreme base of wing purple.....1. *argentifasciella.*
        ee. Thorax and extreme base of wing golden.....2. *scintillans.*
    cc. No median fascia.....4. *quadrinotata.*
  bb. Without such a spot.
    c. Basal third of wing buff.....9. *cerea.*
    cc. Basal third of wing not buff.
      d. A pale costal spot at one-third.....5. *trinotata.*
      dd. Without a pale costal spot at one-third.
        e. Two pale fasciæ.
          f. Thorax creamy buff.....8. *rhamnicola.*
          ff. Thorax dark.
            g. Head black.....7. *intermedia.*
            gg. Head ochraceous.....6. *bifasciella.*
        ee. One pale fascia.
          f. Fascia more or less interrupted.
            g. Male with a chitinous plate from base to near middle of costa of hind wing.
              h. Fascia silvery.....32. *platanella.*
              hh. Fascia not silvery; male with long hair-pencil from base of costa of hind wing.....34. *similella.*
            gg. No such chitinous plate in male.....33. *clemensella.*
          ff. Fascia complete.
            g. Fascia before the middle; wing lusterless.
              h. Whitish costal and dorsal spots at three-fourths. 35. *thoracealbella.*
              hh. No such spots at three-fourths.....40. *latifasciella.*

gg. Fascia in or beyond middle of wing.
h. Apex white .....24. *apicialbella.*
hh. Apex not white (sometimes with white apical cilia).
i. Fore wing almost lusterless; fascia not more shining than remainder of wing.
j. Cilia, creamy white.....31. ***ulmella.***
jj. Cilia gray .....30. *fuscotibiella.*
ii. Fore wing almost lustreless; fascia shining white, silvery, or golden.
j. Collar white .....25. *tiliella.*
jj. Collar not conspicuously paler than the head.
k. Apical cilia white; marginal line defined.
l. Expanse 4 mm.....26. *rubifoliella.*
ll. Expanse 5 to 6 mm.....27. *nyssaefoliella.*
kk. Apical cilia not white; marginal line not defined.
l. Head paler behind.....28. *slingerlandella.*
ll. Head not paler behind.....29. *rosaefoliella.*
iii. Fore wing with a metallic luster; fascia silvery or golden.
j. Fascia preceded by a purple or deep golden brown band. 15. *purpuratella.*
jj. No such band.
k. Fascia the only pale marking.
l. Basal half of wing metallic golden or bronzy; fascia ill-defined internally.
m. Entire apical area deep purple....14. *unifasciella.*
mm. Costal half of apical area purple. 13. *resplendensella.*
ll. Fascia well-defined internally, contrasting with ground color.
m. Wing purple before the fascia, brown beyond. 19. *altella*
mm. Wing not as above.
n. Fascia noticeably beyond the middle.
o. Fascia indistinct.....16. *obscurella.*
oo. Fascia distinct.
p. Entire tuft ochraceous....17. *ostryæfoliella.*
pp. Tuft ochraceous behind only..18. *paludicola.*
nn. Fascia at or near the middle.
o. Tuft black .....22. *quercipulchella.*
oo. Tuft reddish or cherous.
p. Ground color bronzy.
q. Collar pale yellowish (usually). 21. *opulifoliella.*
qq. Collar not pale.....20. *corylifoliella.*
pp. Ground color purplish black. 23. *juglandifoliella.*
kk. With additional silvery or golden markings.
l. A semi-elliptical, golden, metallic spot on dorsum proximal to fascia.....10. *rhoifoliella.*
ll. Metallic markings along termen or at apex.
m. Termen margined with silvery scales from dorsum to apex .....11. *terminella.*
mm. Apex golden metallic, concolorous with fascia. 12. *villosella.*

aa. Fore wings without pale spots or fasciæ.
b. Ground color pale ocherous or yellowish.
c. A purplish fuscous band across apex of fore wing.
d. Fore wing dusted with fuscous scales.
e. A dark brown spot at base of dorsal margin.....42. *nigriverticella.*
ee. No such spot.....43. *populetorum.*
dd. Fore wing not dusted.....41. *cratægifoliella.*
cc. No such band; wing dusted.
d. Tuft fuscous or blackish.....44. *saginella.*
dd. Tuft ocherous .....45. *pallida.*
bb. Ground color, brown with purple or bronzy luster.
c. Fore wing with metallic bronzy or golden reflections.
d. Wing deep reddish or purplish bronzy.....36. *pomivorella.*
dd. Wing paler, with greenish golden reflections.....37. *chalybeia.*
cc. Fore wing dark brown, with faint purple reflections.
d. Tarsi of middle and hind legs pale ocherous.....38. *flavipedella.*
dd. Tarsi of middle and hind legs whitish.....39. *castaneæfoliella.*

1. **Nepticula argentifasciella** Braun. Tuft black behind, ochraceous in front; eye-caps silvery white. Thorax and base of fore wings dark purple. Fore wings dark brown, with metallic reflections. At the basal fifth of the wing is a brilliant silvery fascia, sometimes broadening so considerably on dorsum as almost to reach the base of the wing. At the middle of the wing a second fascia; at extreme apex a silvery patch of scales of variable extent. 4 to 4.5 mm.

Larva in leaves of basswood (*Tilia americana*). Mine narrow serpentine, expanding into a blotch. Cocoon reddish.

There are two or three generations a year. The larvæ become full-grown toward the end of June, in August, and in the latter part of September.

2. **Nepticula scintillans** Braun. Tuft and collar black; eye-caps silvery white. Thorax and base of fore wing golden. Fore wing, except at the base, very dark purple with a silvery fascia across the middle, broadest on the dorsal margin. A second silvery fascia across the apex of the wing. The cilia at the extreme apex dark brown, elsewhere silvery gray. 3 mm. Ohio. Narrow serpentine mines in leaves of haw apple (*Crataegus mollis*); two generations.

3. **Nepticula pteliaeella** Chambers. Tuft dark brown; eye-caps white. Thorax and base of fore wing at the dorsum silvery; a silvery fascia before the middle, a costal and opposite dorsal spot at three-fourths, on a dark brown ground color. Cilia silvery around the apex, becoming brown toward the dorsum. Hind wings dark brown. 4 to 4.5 mm. Kentucky; Ohio.

The larva is a miner in the leaves of the hop tree (*Ptelea trifoliata*); the mine (fig. 12), which is everywhere much contorted, is at first very indistinct, and sometimes blotch-like; later it becomes more distinct.

There are two generations a year. The larvæ may be collected in July and in August and September.

4. **Nepticula quadrinotata** Braun. Head dark brown; eye-caps silvery white. Thorax and fore wings dark brown; markings silvery white, consisting of an elongate spot at base of dorsum, a small spot on the costa before the middle, a larger triangular spot at the tornus, and a similar spot on the costa nearer the apex. 4 to 5 mm. Ohio; Kentucky.

The larva mines leaves of hornbean (*Carpinus caroliniana*) and hazel (*Corylus americana*). The mine is at first linear, usually closely following the midrib or one of the lateral veins; later doubling on itself for a short distance before it expands into an irregular, pale brownish blotch.

There are two generations a year: The larva mines in July and from late August to the middle of October, but is never common.

5. **Nepticula trinotata** Braun. Tuft ocherous, eye-caps whitish. Fore wings with deep blue reflections in the basal third, velvety back beyond, and somewhat irrorated in the apical third, the scales here having pale bluish iridescent bases. At the basal third on the costa is a white spot of variable size, faintly tinted with lilac in some lights. At the apical third there is a costal and an opposite dorsal spot, each shining white and larger than the spot at the basal third. 4.5 to 5 mm. Ohio.

The larvæ form blotch mines on *Carya cordiformis* and occasionally on *C. ovata*

The mine is at first an extremely narrow, linear tract, expanding into a broader tract, which, in turn, becomes a blotch.

There are two generations a year, the mines of the first appearing during the early part of July and those of the second generation, at the beginning of September.

6. **Nepticula bifasciella** Clemens. Tuft ochraceous; eye-caps shining, cream color. Thorax and base of fore wings to the first fascia dark purple; beyond the first fascia, wings dark brown with bronzy reflections; the fasciæ silvery or golden according to the light, the first fascia at one-third, the second at two-thirds of the wing length. 4 to 4.5 mm.

The larva is a miner in leaves of wild cherry (*Prunus serotina*), and occasionally on wild plum (*Prunus americana*). The mine is much contorted, especially at first, often, by confluence, forming a blotch; later distinct. The leaf of wild cherry is discolored and reddish around the mine.

This species is one of the earliest to appear in the spring, the larvæ become full-grown by the middle of May; later generations appear in June and July and in September.

7. **Nepticula intermedia** Braun. Head black; eye-caps silvery white. Thorax bronzy, base of fore wing plum-purple, followed by a shining silvery or golden fascia. Beyond this fascia wing dark brown, with but faint bronze reflections. A second silvery or golden fascia crossing the wing at two-thirds. 3 to 3.5 mm. Ohio; Kentucky.

This species makes serpentine mines on leaves of sumac (*Rhus* spp.). Usually there are but two generations a year, the larvæ maturing in July usually overwintering, but occasionally a third generation appears.

8. **Nepticula rhamnicola** Braun. Tuft ocherous in the summer generation, black in the overwintering generation. Thorax creamy buff, patagia dark brown. Fore wings brown, the tips of the scales blackish. At the basal third of the wing a cream-colored fascia with its edges often indented by dark scales. At two-thirds of the wing length a more shining silvery fascia. 4.5 to 5.5 mm. Ohio.

The larvæ are found in the leaves of *Rhamnus lanceolata;* the mine is at first linear, contorted, and on lower surface; later it crosses to the upper side where it finally becomes a blotch. There are three generations; the mines are most abundant in October.

9. **Nepticula cerea** Braun. Head buff; eye-caps a little paler. Thorax and base of fore wings to just beyond one-third, creamy buff. From the base a few fuscous scales extending along the costa to the middle of the pale area, where they join a small, triangular, fuscous spot which is sometimes faintly connected with the dorsum by a few scattered fuscous scales. Following the pale basal area, a broad dark-brown band across the wing, succeeded by a narrower, silvery white fascia. The apical third of the wing dark brown, except for the pure white cilia at the apex. 3.5 mm. Ohio; Pennsylvania.

10. **Nepticula rhoifoliella** Braun. Head black; eye-caps silvery white. Thorax blackish purple. Fore wings very lustrous, base of the costa plum-purple. A large, semi-elliptical patch of scales just beyond the base of the wing and resting on the dorsum, but not reaching to the extreme costa, of deep, brilliant golden,

shading along its edges into reddish bronze. Beyond this, wing deep purple with bronze reflections; wing crossed at three-fifths its length by a straight, shining, silvery or pale golden fascia. 3.5 mm.

Ohio; Kentucky; Missouri.

The larvæ make contorted, serpentine mines on the upper side of leaves of poison ivy (*Rhus toxicodendron*).

There are three generations; mature larvæ may be found in June, toward the end of July, and in September.

11. **Nepticula terminella** Braun. Tuft on the face dull brownish, on the vertex and head black; collar and eye-caps shining white, with a very faint yellow tinge. Thorax bronzy. Costal half of the fore wing to the fascia, blue-purple, the blue predominating at the extreme edge; below the costa the wing shading into a deep, brilliant, golden color, becoming more bronzy as it nears the fascia. Fascia situated just beyond the middle of the wing, almost straight, and with a brilliant, silvery luster. Apical third of the wing blue-purple, blue predominating. Just below the apex a double row of silvery scales margining the termen, becoming a single row toward the dorsum, and sometimes connected with the fascia. 5 to 5.5 mm.

Ohio; Kentucky; Pennsylvania.

The mine is seen on various species of oak, though most commonly on red oak (*Quercus rubra*) and pin oak (*Q. palustris*), it is a pale greenish, gradually broadening, linear tract, 3.5 mm. wide at the end. The larva is yellow, even when very young. Thus this mine can early be distinguished from the other linear mines on oak.

There are three generations a year, and in favorable seasons, a fourth.

12. **Nepticula villosella** Clemens. Tuft orange-ochraceous; eye-caps pale golden. Thorax and fore wings to the fascia brilliant, metallic bronzy, somewhat purple at the base of costa; fascia at two-thirds golden. Wing beyond the fascia blue-purple, with a large spot at the apex and the apical cilia golden, concolorous with the fascia. 4.5 mm.

The larva is a miner in leaves of blackberry (*Rubus* spp.) and occasionally wild raspberry (*Rubus occidentalis*). The mine is a tortuous, brown, linear tract scarcely broader than the pale brownish larva within.

There are three generations.

This is distinguished from all other species by the metallic golden apex.

13. **Nepticula resplendensella** Chambers. Palpi whitish, tuft pale reddish saffron. Fore wings, including cilia, with a brilliant metallic luster, golden or silvery, except the basal half of the costal margin, and a large spot extending along the base of the costal cilia nearly to the tip and more than half way across the wing, which is deep purple. Tips of tarsi pale yellowish. 6 mm.

Kentucky.

14. **Nepticula unifasciella** Chambers. Head orange-ochraceous; eye-caps silvery white. Upper surface of thorax and basal two-thirds of fore wing brilliant metallic bronzy or golden, except toward the costal margin where the color shades into purple, so that a silvery or golden fascia at the apical third is scarcely defined internally. Behind the fascia, wings deep purple. Cilia purple, golden at their tips. 4.5 mm.

Kentucky; Texas; Ohio.

15. **Nepticula purpuratella** Braun. Tuft ochraceous or orange; eye-caps silvery white. Thorax deep bronzy or golden. Extreme base of the fore wing concolorous with the thorax, shading outwardly to a paler, lustrous, golden color, and this, at the outer limits of the basal third, followed by a deep, bronzy band with purple and reddish reflections varying in intensity, and occupying approximately the middle of the wing. This followed by a brilliant, silvery fascia. Apical area beyond the fascia deep bronzy, usually suffused with brilliant purple. The purple

reflections sometimes almost entirely absent, so that the dark band preceding the fascia and the apical area are deep bronzy-golden. 4.5 to 4.8 mm.

Pennsylvania.

16. **Nepticula obscurella** Braun. Tuft ocherous, eye-caps whitish. Fore wings shining golden brown, tinged with bronze along the extreme costa and in the apex. Just beyond two-thirds of the wing-length, an indistinct, narrow, whitish fascia, broadest in the middle of the wing and fading out toward the ends. Viewed from some angles, this fascia scarcely visible. Cilia of the general hue, their tips around the apex paler, however, and concolorous with the fascia. 3.5 mm.

New Jersey; New York.

The mine is a narrow serpentine track on the upper side of bayberry (*Myrica carolinensis*). There are two generations a year.

17. **Nepticula ostryaefoliella** Clemens. Tuft ochraceous; eye-caps and collar shining cream-colored. Thorax and fore wings shining brown with faint bronzy and purple reflections, which become deeper toward the predominantly purple apex. At two-thirds of the wing length is a shining silvery fascia. Cilia tipped with white around the apex. 4 mm.

Pennsylvania; Ohio; Kentucky; North Carolina; British Columbia.

The mine is a rather broad, serpentine track, gradually increasing in breadth to the end, where it measures about 2 millimeters across; it occurs on various species of birch (*Betula* spp.) and on hop hornbeam (Ostrya).

18. **Nepticula paludicola** Braun. Distinguished from the preceding species by the following characters: tuft clay-colored or fuscous on the face, shading to buff or ochraceous on the head; fascia slightly nearer the base. 3.5 to 4.5 mm.

New Jersey; Ohio.

The mine is a serpentine track on leaves of cranberry (*Oxycoccus macrocarpus*).

19. **Nepticula altella** Braun. Tuft orange-ochraceous in front, becoming pale behind; eye-caps creamy white. Thorax dark purplish brown. Fore wings before the fascia purple-brown, beyond it brown with purple reflections; general color to the naked eye deep purple before the fascia and brown beyond it. A silvery fascia crosses the wing at three-fifths, and is usually a little broader on the margins of the wings. 6.5 to 7 mm.

Southwestern Ohio, locally in pin-oak forests.

The species has but one generation a year, the moths appearing in May. The mines are found only on the first leaves of the pin oak (*Quercus palustris*) that appear in the spring, never on the leaves that come later. The mine, which may best be regarded as a lower-side mine, is at first much contorted, winding and twisting within a small area, and causing a brownish discoloration of the surrounding leaf. This part of the mine seems to be formed early in the season, and the leaf around it is always dead when, in October, further feeding is resumed. At this time the larva starts out to mine into the fresh, green part of the leaf, where the mine is more distinct, due to the larva's partial eating of the leaf substance. The larva then becomes full-fed in a week or ten days and leaves the mine to spin a dark brown cocoon. The mine is extremely long but measures only 1 to 1.5 mm. in width at its end. The larva is yellow, with a row of dark brown dashes along the mid-ventral line.

This species may be separated from all other species by the fact that the wing is purple before the fascia and brown beyond, the reverse being true in all other cases where there is a difference in color before and behind the fascia.

20. **Nepticula corylifoliella** Clemens. Tuft ocherous to orange-ochraceous. Eye-caps silvery white, sometimes shading to fuscous outwardly. Thorax and fore wings bronzy brown, with blue-purple reflections toward the costa and in the entire apical part of the wing beyond the fascia, the color being there predominantly purple. The purple reflections sometimes entirely lacking proximal to the fascia. Fascia situated just beyond middle of wing, rather broad, narrowing toward the costa. Cilia silvery-tipped at the apex. 3.5 mm.

The food plants of *N. corylifoliella* include hazel (*Corylus americana*), hop hornbeam (*Ostrya virginiana*), hornbeam (*Carpinus carolinina*), and black birch (*Betula lenta*). The mine is a long, very narrow, winding tract, scarcely broader than the larva. The larvæ may be found in June and early July, and from late August until October.

21. **Nepticula opulifoliella** Braun. Tuft ochraceous; collar usually pale yellowish; eye-caps pale, shining buff, sometimes fuscous outwardly. Thorax dark fuscous, with purple and blue reflections. Fore wings with pronounced purple and blue reflections toward the costa and beyond the fascia, shading to bronzy green below the fold. At three-fifths of the wing length a broad, very shiny, silvery fascia with faint, golden luster. 3.5 to 4 mm.

Ohio; North Carolina.

The larvæ form brownish, much contorted, serpentine mines in leaves of Opulaster (*Physocarpus opulifolius*). There are two generations, the larvæ appearing in July and September.

This species is very close to *N. corylifoliella*, from which it is difficult to distinguish it. The pale collar, when present, is a reliable character. The more yellowish eye-caps, and the less lustrous wing, with the absence of reddish tints, will aid in distinguishing this species from *N. corylifoliella*.

22. **Nepticula quercipulchella** Chambers. Head black; collar and eye-caps yellowish white, silvery; thorax and fore wings deep blue-black, bronzed, and with purple and violet reflections; the fascia behind the middle, silvery white and a little the widest on the dorsal margin; wing behind the fascia darker than before it, but cilia paler and less lustrous than wing. Under surface of wing, abdomen, and legs cupreous black. 4 mm.

Kentucky.

The above description is essentially that given by Chambers. According to him "the larva is bright green, with a deeper green line of contents; it makes a long, narrow, winding, and gradually widening track, similar to that of *N. quercicastanella* Chambers in leaves of *Quercus alba*." Chambers asserts that the larva from which he bred the type specimen formed a new mine when nearly grown, a fact, if true, at variance with all observations on this group.

23. **Nepticula juglandifoliella** Clemens. Tuft ochraceous, eye-caps and collar shining creamy white. Thorax and fore wings deep purplish black, uniformly purple beyond the fascia which is situated just beyond the middle; silvery white and broadest on the dorsum. 3.5 to 3.8 mm.

The mine is a serpentine track, usually whitish, and is found on various species of hickory and on walnut and butternut. The larva is pale green (almost white when feeding on walnut).

There are three generations. Full-grown larvæ may be found in the middle of June, the latter part of July, and in late August and early September.

The purple fore wings and white collar distinguish this species from its nearest allies.

24. **Nepticula apicialbella** Chambers. Tuft ochraceous, collar creamy white, eye-caps white. Thorax dark purplish brown. Fore wings dark brown, with a faint, purple luster. Beyond the middle of the wing is a narrow, oblique white fascia, convex outwardly and reaching the margin farther from the base on the dorsum. The scales at extreme tip of wing white, forming, with the whitish apical cilia, a very distinct pale patch. 4 mm.

Kentucky; Ohio.

The larvæ make upper-side, serpentine mines on elm. The mine is brownish in color, with a conspicuous line of frass through the middle.

There are three generations. The full-grown larvæ are found in mid-June, late July, and in August and September.

The oblique fascia and white apex distinguish this species from all others.

25. **Nepticula tiliella** Braun. Tuft ochraceous, collar white. Antennæ black, eye-caps shining white. Fore wings almost black, with a very faint, purple luster. At the middle of wing a shining, pure white fascia, slightly oblique and a little convex outwardly. Cilia gray on the dorsum, shining white from the tornus to the costa. 3.5 mm.

Ohio; Kentucky.

The larvæ make serpentine mines on the upper side of leaves of basswood (*Tilia americana*). The mine is characterized by the tendency toward a spiral form, with either the early or the later part inside, and by the frequency of angular turns.

There are two generations, the full-grown larvæ appearing in early July and late August.

The pure white fascia and the white cilia, against which the outermost row of black scales is sharply defined, distinguish this species.

26. **Nepticula rubifoliella** Clemens. Head ocherous; eye-caps silvery white. Thorax and fore wings almost black, with a shining silvery, or faintly golden, fascia at the middle of the wing; fascia convex outwardly and somewhat narrowed at its middle, sometimes almost interrupted. Cilia whitish, so that the marginal line of scales is defined. 4 mm.

The larvæ mine leaves of blackberry, forming at first very narrow, linear mines, which closely follow a vein or the margin of the leaf before enlarging into an irregular blotch.

Mines containing the larvæ may be collected in July and September.

27. **Nepticula nyssæfoliella** Chambers. Tuft ochraceous; eye-caps shining white. Thorax and fore wings black with very faint, purple reflections. In the middle of the wing a shining silvery, or pale golden, fascia, slightly convex outwardly. Cilia around the apex white, with marginal line of scales defined. Hind wings pale gray, with an oval patch of androconia in the male. 4.5 to 6 mm.

The larvæ mine in the leaves of sour gum (*Nyssa sylvatica*), forming narrow, linear mines (fig. 59) which abruptly enlarge into blotches measuring 2 cm. or more in length, with an average width of 5 or 6 mm. There are two or three generations a year, the larvæ of the first generation becoming full-grown in June.

This is one of the most abundant species; moths may often be collected in great numbers in the vicinity of the food plant.

From *N. rubifoliella*, its nearest ally, it is distinguished by its larger size and the equal breadth of fascia throughout.

28. **Nepticula slingerlandella** Kearfott. Tuft ochraceous, becoming paler behind, where it merges into the pale ocherous or whitish collar. Eye-caps white. Thorax and fore wings black with a faint bronzy luster, somewhat irrorated beyond the shining white fascia situated just beyond the middle of the wing. Cilia pale gray. 3.5 to 5 mm.

New York; Ohio.

The larvæ mine leaves of cultivated plums and prunes, wild plum (*Prunus americana*), and occasionally sweet cherry, forming narrow, linear mines which abruptly enlarge into irregular blotches. This species attains economic importance in the plum orchards of northern New York, where its ravages have been the subject of a bulletin by C. R. Crosby, in which are given further details of its life history, together with numerous figures. There is a single generation of moths in New York, and the larvæ which are full grown in July do not produce moths until the following year. Farther south, a second brood of larvæ may usually be collected in September.

29. **Nepticula rosæfoliella** Clemens. Tuft ochraceous; eye-caps shining creamy white. Fore wings almost black, with a very faint, dark blue and bronzy luster. Just beyond the middle of the wing is a rather broad, straight, silvery, or very pale, golden fascia. Cilia of the general hue, scarcely paler tipped opposite the apex. 4.5 mm.

The larva mines the leaves of various species of rose. The mine is serpentine, usually much contorted, and frequently closely follows the edge of the leaf in its early course. A broad line of frass is visible. The mine at its end measures 1.5 to 2 mm. across. There are three generations, the larvæ being full-grown in June and early July, in August, and in October. Mines containing larvæ may, however, be found at almost any time during the summer and fall up to November.

This species may be distinguished from *N. slingerlandella* by the darker head, dark cilia, and somewhat broader wings.

30. **Nepticula fuscotibiella** Clemens. Tuft ochraceous; eye-caps whitish. Thorax and fore wings fuscous, faintly purple, with the scales before the fascia paler at their bases, so that this part of the wing is somewhat irrorated and paler than that beyond the fascia where the wing is dark fuscous purple. Fascia just beyond the middle, dull white, sometimes a little convex and broadening on the dorsum. Cilia gray, pale gray around the apex. 4 to 4.5 mm.

The larvæ mine leaves of various species of willow. The mine is a gradually broadening, linear tract, sometimes straight, but often bent back on itself toward the end. Occasionally (on *Salix discolor*) its latter part is a more or less spiral blotch. There are at least three generations a year. The larvæ may be collected from June until the end of October.

31. **Nepticula ulmella** Braun. Tuft ocherous on face, tinged with red above, and sometimes with a few dark brown scales behind. Antennæ creamy white, broadly banded above with dark brown, so that only a narrow line of the pale color appears between the annulations. Eye-caps creamy white. Thorax brownish, somewhat peppered. Scales of the fore wing creamy white, shading to dark brown at their tips, except where they form a creamy white, oblique fascia at the middle of the wing. The general color of the fore wing is thus a somewhat mottled, dark brown. Fascia, from the middle of the wing on the costa, extending to dorsum somewhat behind the middle, and sometimes broken with a few, dark-tipped scales. Cilia creamy white. 4 to 5 mm.

The larvæ are miners in leaves of red elm and cork elm (*Ulmus fulva* and *U. racemosa*). The mine starts as a very fine brown, or, rarely, whitish, line, abruptly enlarging to a breadth of 1 mm., then increasing gradually in width, until it attains a breadth slightly in excess of 2 mm. The broad portion of the mine is usually so much contorted that it is not possible to trace the course of the mine, the whole having the appearance of an irregular blotch.

There are two generations, the mature larvæ being found in July and in September.

The creamy white fascia and cilia, together with the pale bases of the scales, distinguish this species.

32. **Nepticula platanella** Clemens. Tuft pale ocherous to ochraceous; eye-caps silvery white. Thorax and fore wings dark brown with a bluish luster. At middle of costal margin a small oblique silvery streak, and opposite it on the dorsal margin is a similar streak, usually larger than the costal streak and broader on the margin. Rarely both spots are very minute. Occasionally these two streaks meet, forming a more or less interrupted concave fascia. Last row of scales around the apex pale yellowish at their bases, thus forming a dark line in the whitish cilia. Hind wings yellowish fuscous, in the male with a sword-shaped, yellowish, chitinous plate on the upper side from base to near middle of costa, margined along the costa with bristly black scales. Beyond this costa excised. 5.5 to 7 mm.

The mines are abundant on leaves of sycamore (*Platanus occidentalis*) and begin as slender, linear tracks usually filled with frass. Several days before pupation, the mine is abruptly enlarged into a large, usually almost circular blotch, which in many instances covers the linear part of the mine.

There are three generations of larvæ, the earliest being found during June.

There is considerable variation in the size of the white spots and it is but rarely that they form a fascia. Females may be distinguished from specimens of *N. clemensella* by their larger size, and the males from that species and all others except *N. similella*, by the peculiar chitinous plate along the costa of the hind wing.

33. **Nepticula clemensella** Chambers. Tuft ochraceous; eye-caps silvery white. Fore wings bluish black. A narrow, oblique, silvery streak on the middle of the costa (rarely inconspicuous) and an opposite dorsal streak, usually meeting in the male to form a narrow, oblique fascia. Cilia silvery with a brown line formed by the dark tips of the terminal row of scales around the apex. Hind wings yellowish fuscous, similar in both sexes. 4.5 to 5.2 mm.

The larva mines in the leaves of sycamore (*Platanus occidentalis*), forming a linear mine which gradually increases in breadth. Its terminal portion expands into a small blotch, three or four times the diameter of the end of the linear mine. There are three generations a year.

This species is much less common than *N. platanella* and uniformly smaller, the largest specimens scarcely attaining the expanse of the smallest *N. platanella*.

34. **Nepticula similella** Braun. Tuft ocherous to ochraceous; eye-caps silvery white, occasionally tinged with ocher. Thorax and fore wings deep bluish black, the extreme bases of the scales more or less iridescent blue, especially in the apical half of the wing. At the middle of the wing an oblique narrow, costal streak, shining white but not silvery, usually meets the apex of a shorter, broader, dorsal streak. Tips only of the last row of scales around apex dark, thus forming a dark line in the white cilia. Hind wings gray; in the male with a narrow, chitinous plate from base to one-third of costa, with a long, yellowish, costal hair-pencil lying along it. 5 to 6 mm.

Ohio; Kentucky.

The larva makes a characteristic mine in the leaves of pin oak (*Quercus palustris*) and occasionally of chestnut. The early part of the mine is very narrow, completely filled with frass, and bent several times in close, S-shaped curves. The larva next mines just above the lower epidermis, forming a blotch scarcely visible above except for occasional spots here and there toward the edges of the blotch, where the leaf substance is more fully consumed. During the last stage, a conspicuous large blotch is formed, where the mine is transparent and whitish, with the frass accumulated toward the beginning of the blotch.

Females of this species can only be distinguished from those of *N. platanella* by their less shining costal and dorsal spots; the males differ in the yellowish costal hair-pencil of their hind wings.

35. **Nepticula thoracealbella** Chambers. Tuft ochraceous on the face, becoming reddish brown on the vertex; eye-caps white. Thorax white, with a few, scattered, dark brown scales in occasional specimens. Fore wings dark brown, slightly irrorated; a creamy white, irregular fascia just before the middle, concave toward the base and usually wider on the dorsal margin; at the apical fourth a distinct, creamy-white, costal spot, and an opposite dorsal spot, whose apices occasionally touch; cilia creamy white, sometimes grayish on the dorsum. 4 to 5 mm.

Kentucky; Ohio; Pennsylvnia.

36. **Nepticula pomivorella** Packard. Tuft orange-ochraceous; eye-caps and collar shining pale buff. Thorax and fore wings shining bronzy, with strong purple and blue reflections increasing toward the apex. 5 mm.

The larvæ make long, narrow, serpentine tracks (fig. 61) in the leaves of apple, gradually widening the mine to 2 or 2.5 mm. at the end.

37. **Nepticula chalybeia** Braun. Tuft ocherous, sometimes shading to reddish brown above; collar yellowish white; antennæ fuscous; eye-caps yellowish white. Thorax steel-gray. Fore wings very narrow, steel-gray with faint, greenish golden reflections. 3.5 to 4 mm.

Ohio.

The larvæ mine leaves of wild pear (*Pyrus communis*) and cultivated pear, making rather short, serpentine tracks, often not exceeding 2 cm. but sometimes reaching 3 cm. in length, and broadening to 1.5 to 2 mm. across at the end. There are three generations a year. Mined leaves may be collected in early June, in July, and during the last part of August.

Its paler color, with the absence of purple, the narrow wings, and its smaller size distinguish this species from *Nepticula pomivorella.*

38. **Nepticula flavipedella** Braun. Tuft usually dark brown, collar creamy white; rarely tuft reddish ocherous on the face, and brown on the vertex; eye-caps creamy white. Thorax dark purplish brown. Fore wings dark brown, with dark blue and purple reflections; cilia with silvery tips. Fore legs, except the femora, dark brown; middle legs pale silvery, tarsi pale ochreous; hind legs silvery, tibiæ dark brown, tarsi pale ocherous. 3.5 to 4.5 mm.

Ohio; Kentucky.

The mine is a very characteristic linear tract, found most commonly on pin and swamp white oak, but occasionally on other species of oak. The larva, for the first few millimeters, mines near the upper surface, making a very narrow indistinct mine. Then the mine is slightly but abruptly enlarged and for a length of 8 or 9 mm., the leaf substance is entirely consumed and the mine rendered transparent. Then follows another enlargement, and the mine, often much contorted, increases very gradually in breadth to the end where it measures 2 mm. across. The latter part of the mine is not transparent, but the mine is distinctly visible.

There are three generations a year. Mined leaves may be collected during early June, the latter half of July, and the early part of September.

Though very distinct in larval work, this species in the imaginal state is almost indistinguishable in appearance from *N. castaneæfoliella.* The yellowish middle and hind tarsi and the deeper purple suffusion of the fore wings are, however, constant differences.

39. **Nepticula castaneæfoliella** Chambers. Tuft black; collar, eye-caps, and palpi creamy white. Thorax and fore wing dark brown, with slight bronzy and purple reflections; tips of scales somewhat darker, so that under a lens the wing is slightly irrorated, especially toward the apex. Cilia silvery at the tips. Posterior tibiæ and fore legs, except the femora, dark brown; legs otherwise whitish. 4 to 4.5 mm.

Kentucky; Ohio; Virginia.

The larvæ form very long, much contorted, linear mines in the leaves of chestnut (*Castanea dentata*) and oak. They measure but little over 1 mm. in width at the end, and have a fine, central line of frass.

40. **Nepticula latifasciella** Chambers. Tuft on the face ocherous, dark brown on the vertex; collar and eye-caps creamy. Thorax and extreme base of fore wings creamy-buff. Remainder of fore wing deep purple-brown, with a very broad, creamy-buff fascia just before the middle; two or three creamy-buff scales at the extreme apex, forming with the creamy-white cilia around the apex, a conspicuous pale spot. Cilia elsewhere gray. 4 to 4.5 mm.

The larvæ mine leaves of oaks, and probably chestnut. Although the mine varies in length from 3 to 5 cm. on different species of oak, with a breadth of about 1.5 mm. at its end it has in general the same appearance. The frass is at first deposited in a broad, blackish line through the center, later dispersed across the entire breadth, and, toward the end, collected into a broad band.

This is one of the earliest species to appear in the spring; the moths may be found resting on tree trunks during the latter part of April. Mines may be found in June, the latter part of July, in September, and often during late October.

41. **Nepticula cratægifoliella** Clemens. Tuft ocherous, faintly tinged with red above. Antennæ ocherous, partly suffused with fuscous; eye-caps ocherous. Thorax

and fore wings ocherous, the extreme edge of the costa near the base purplish fuscous, and a broad, purplish fuscous band at the apex of the wing. The cilia, beyond this band, pale ocherous, giving the appearance of an ocherous apex preceded by a dark band. Cilia opposite the ends of the band concolorous with it. 3.5 to 4.5 mm.

Pennsylvania; Ohio; Kentucky.

The mines occur on several species of hawapple. The mine is comparatively short, rapidly increasing in diameter and measuring about 2 mm. in width in the later part of its course.

There are two generations a year. Larvæ may be collected in early July and at the beginning of September.

This species is distinguished from all others with yellowish ground color by its entire absence of dusting. The much broader mine and bright green larva distinguish it, in its early stages, from *N. scintillans.*

42. **Nepticula nigriverticella** Chambers. Face ochraceous, tuft above dark brown; collar and eye-caps pale ocherous, antennal stalk fuscous. Thorax and fore wings pale ocherous, dusted with purplish black scales. At the base of the dorsal margin a purplish black spot extending halfway across the wing, and occasionally, as a narrow line, reaching the costa, which is often dark brown near the base. At the beginning of the cilia a broad, purplish-black fascia; beyond it cilia pale ocherous. 5 mm.

Kentucky; Ohio; Texas.

43. **Nepticula populetorum** Frey and Boll. Tuft ocherous, becoming dark brown behind. Collar and eye-caps pale creamy. Thorax and fore wings buff or pale ocherous, more or less densely dusted with purplish fuscous scales. These scales form a purplish fuscous fascia at the beginning of the cilia. Cilia pale gray, whitish around apex. 5 mm.

Texas; Ohio; Kentucky; California.

The larvæ mine the leaves of several species of poplar, commonly the leaves of cottonwood (*Populus deltoides*). The mine is indiscriminately placed on the upper or the lower side of the leaf. It is whitish, gradually broadening, linear track, 2 to 2.5 mm. in width at its extremity.

This species differs from the preceding in the absence of the dark spot at the base of the dorsum.

44. **Nepticula saginella** Clemens. Face ocherous or pale buff, head, above, dark brown; collar and eye-caps pale ocherous. Thorax and fore wings pale ocherous, buffish, or even whitish, and dusted with fuscous scales, often more densely dusted toward the outer half of the wing, where the dark scales are either evenly distributed or collected into spots, but never form a band. Cilia pale ocherous. 4 to 5.5 mm.

The mine (fig. 60) is a whitish, linear tract on various species of oaks and on chestnut; it varies in length and width, but is usually about 1.5 to 2 mm. wide at its extremity. The larvæ are found from June to October.

45. **Nepticula pallida** Braun. Tuft ocherous; the scales on the vertex tipped with orange; antennæ pale ocherous, eye-caps whitish. Fore wings very pale buff, evenly dusted with purplish gray, a little more densely toward the apex of the wing. Cilia very pale buff. 4 mm.

Cedar Point, Ohio.

The food plant of *N. pallida* is willow, *Salix* sp. The mine (fig. 58) is made on the lower side of the leaf and is extremely narrow at first, extending along the midrib, later doubling on itself once or twice, and gradually and evenly increasing in breadth to its end, where it measures a scant 1.5 mm. across. The entire length of the mine is approximately 4.5 cm.

The pale head distinguishes this species from *N. saginella.*

In addition to the above species, there are several species, namely *N. amelanchierella, N. anguinella* and *N. platea,* which are still known only in the larval state. Their mines are described in the *Synopsis of species by food plants.*

Synopsis of species by food plants

Salix spp., willow:
(1) *N. pallida*; mine linear, narrow at the end.
(2) *N. fuscotibiella*; mine linear, gradually broadening, club shaped at the end, sometimes blotch-like toward the end.

Populus grandidentata, poplar:
(1) *E. populella*; globular swelling of petiole close to leaf.

Populus deltoides, cottonwood:
(1) *N. populetorum*; whitish mine, gradually increasing to a breadth of 2 to 2.5 mm. at end.

Myrica carolinensis, bayberry:
(1) *N. obscurella*; mine serpentine, very narrow.

Juglans cinerea, butternut:
(1) *N. juglandifoliella.*

Juglans nigra, walnut:
(1) *N. juglandifoliella;* serpentine mine, very gradually increasing in breadth.

Carya spp., hickory:
(1) *N. juglandifoliella*; serpentine mine, very gradually increasing in breadth.
(2) *N. trinotata*; linear track, expanding into a blotch.

Corylus americana, hazel:
(1) *N. corylifoliella*; very narrow, serpentine mine, scarcely broader than the larva.
(2) *N. quadrinotata*; narrow linear mine, expanding into an irregular blotch.

Ostrya virginiana, hop hornbeam:
(1) *N. corylifoliella*; very narrow, serpentine mine, scarcely broader than the larva.
(2) *N. ostryæfoliella*; linear track, gradually reaching a breadth of 2 mm., at the end.

Carpinus caroliniana, hornbeam:
(1) *N. corylifoliella*; very narrow, serpentine mine, scarcely broader than the larva.
(2) *N. quadrinotata*; narrow linear mine, expanding into an irregular blotch.

Betula spp., birch:
(1) *N. corylifoliella*; very narrow, serpentine mine, scarcely broader than the larva.
(2) *N. ostryæfoliella*; linear track, gradually reaching a breadth of 2 mm. at the end.

Castanea dentata, chestnut:
(1) *N. castaneæfoliella*; long, contorted mine, with central line of frass; larva green.
(2) *N. saginella*; shorter, whitish mine, with frass in a central line or dispersed; larva green.
(3) *N. latifasciella*; serpentine mine; frass at first in a broad line, later, dispersed, and toward end gathered into a band; larva green.
(4) *N. similella*; see under Quercus (8).
(5) *E. castaneæ*; larva makes a gall encircling twig.
(6) *E. phlœophaga*; larva makes a serpentine track in the bark.

Quercus spp., oaks:
(1) *N. terminella*; mine a broadening, linear tract, 3.5 mm. wide at the end; larva yellow.
(2) *N. saginella*; whitish, linear mine with frass in a central line or dispersed; larva green.
(3) *N. latifasciella*; serpentine mine; frass at first in a broad line, later, dispersed, and toward the end gathered into a band; larva green.
(4) *N. flavipedella*; linear mine; a short, indistinct part followed by a transparent area, and then a gradually broadening, serpentine track, not transparent, but easily visible above; larva green.

(5) *N. anguinella* Clemens, Proc. Ent. Soc. Phila., vol. 1, p. 85, 1861; Tin. No. Am., 175, 1872. "May be found in the leaves of oaks early in October and in the latter part of June. The mine is a very narrow serpentine tract, *which is filled or discolored throughout its length by blackish excrement.* The larva fits the mine closely, in color lemon-yellow, with ten square dark brown or blackish spots on the ventral surface."

It should be possible to recognize this species, when found, from Clemens' description of the larva.

(6) *N. platea* Clemens, Proc. Ent. Soc. Phila., vol. 1, p. 85, 1861; Tin. No. Am., 175, 1872. "Mines oaks early in October. The mine is a moderately broad, winding tract, with a broad line of dispersed grains of excrement. The larva is purplish, with a pale green vascular line and a row of reddish-brown dorsal dashes. The mine is much broader than that of the preceding miner."

The statement that the larva is purple cannot be regarded as conclusive, since such color is often produced in larvæ feeding on leaves with autumnal coloration.

Quercus alba, white oak:

(7) *N. quercipulchella*; long, narrow, winding and gradually widening track; larva bright green.

Quercus palustris, pin oak:

(8) *N. similella*; linear mine, expanding into an underside blotch, followed by a large, conspicuous, nearly transparent blotch; larva pale green.

(9) *N. altella;* lower-side, very long, serpentine mine, not distinctly visible; larva yellow with row of dark brown dashes.

(10) *E. heinrichi;* flattened-oval, spiral mine in bark of young branches.

Ulmus spp., elms:

(1) *N. apicialbella*; narrow, serpentine mine.

(2) *N. ulmella*; narrow, linear track, enlarging into an irregular blotch.

Platanus occidentalis, sycamore:

(1) *N. platanella*; narrow, linear mine, abruptly enlarging into a large blotch.

(2) *N. clemensella*; linear mine, gradually broadening with terminal portion expanded into a small blotch.

Physocarpus opulifolius, Opulaster:

(1) *N. opulifoliella*; brownish, contorted, serpentine mine.

Pyrus communis, pear:

(1) *N. chalybeia*; serpentine mine.

Pyrus malus, apple:

(1) *N. pomivorella*; serpentine mine, usually broadening to 2 or 2.5 mm.

Amelanchier canadensis, service berry:

(1) *N. amelanchierella* Clemens, Proc. Ent. Soc. Phila., vol. 1, p. 84, 1861; Tin. No. Am., 174, 1872. "In the leaves of service-berry or June-berry, *Amelanchier canadensis*, in June and July. The mine rather a broad tract, sometimes much contorted, with rather irregular edges, placed most often towards the base of the leaf and having a rather broad "frass" line of a dark brown color."

This species seems to be distributed wherever its food plant occurs; mines observed in Ohio, Kentucky, North Carolina.

Cratægus spp., hawapple:

(1) *N. cratægifoliella*; serpentine mine, with a breadth of about 2 mm. at the end.

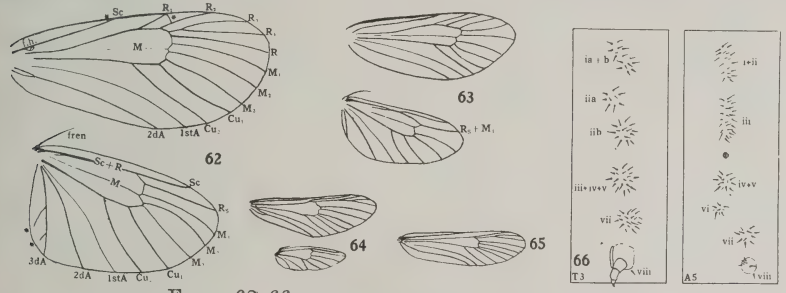
(2) *N. scintillans*: contorted, serpentine mine, scarcely exceeding 1 mm. in breadth.

Rubus spp., blackberry, raspberry:
(1) *N. villosella*; narrow, serpentine mine.
(2) *N. rubifoliella*; short, narrow, linear mine, expanding into a blotch.
Rosa spp., rose:
(1) *N. rosæfoliella*; serpentine mine.
Prunus serotina, wild black cherry:
(1) *N. bifasciella*; narrow, serpentine mine.
Prunus americana, wild plum:
(1) *N. bifasciella*; narrow, serpentine mine.
(2) *N. slingerlandella*; narrow, linear mine, abruptly enlarging into an irregular blotch (also on cultivated plums and prunes, and sweet cherry).
Ptelea trifoliata, hop tree:
(1) *N. pteliœella*; very long, much contorted, narrow, serpentine mine.
Rhus toxicodendron, poison ivy:
(1) *N. rhoifoliella*; narrow, contorted, serpentine mine.
Rhus spp., sumac:
(1) *N. intermedia*; narrow, contorted, serpentine mine.
Acer saccharum, sugar maple:
(1) *Glaucolepis saccharella*; very long, linear mine.
Acer rabrum, red maple:
(1) *Glaucolepis saccharella*; very long, linear mine.
Rhamnus lanceolata, buckthorn:
(1) *N. rhamnicola*; linear mine, expanding into an irregular blotch.
Tilia americana, basswood:
(1) *N. tilliella*; serpentine mine.
(2) *N. argentifasciella*; indistinct, linear mine, expanding into a blotch.
Nyssa sylvatica, sour gum or pepperidge:
(1) *N. nyssœfoliella*; linear mine, abruptly expanding into a blotch.
Oxycoccus macrocarpus, cranberry:
(1) *N. paludicola*; serpentine track, in part following the margin of the leaf.

SUPERFAMILY ZYGÆNOIDEA

(Slug caterpillars)

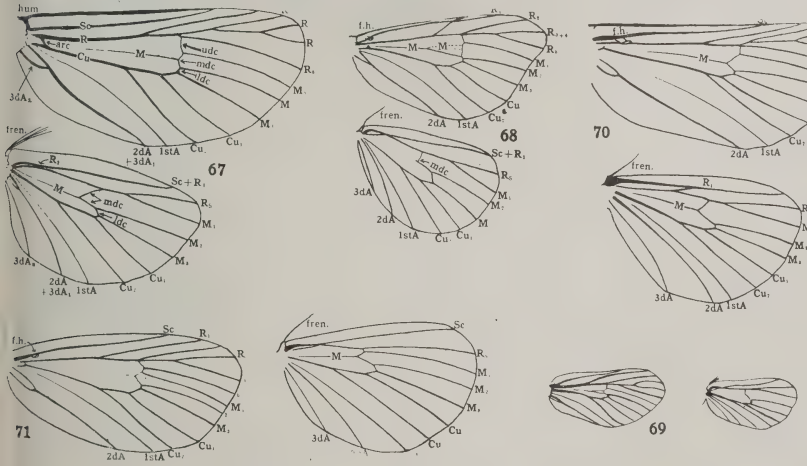
This series, which seems to be derived from a stock intermediate between the Hepialidæ and the lowest known Tineidæ, apparently became adapted very early, in the larva, to external feeding. The



FIGS. 62–66. ZYGÆNOIDEA: PYROMORPHIDÆ

62, *Pyromorpha dimidiata*, ♀, venation. (The asterisks indicate accessory veins, the other abbreviations as in figure 19.); **63,** *Acoloithus falsarius*, venation; **64,** *Harrisina texana*, venation; **65,** *Harrisina americana*, venation of fore wing; **66,** *Zygæna trifolii* (*Zygænidæ*, Europe), seta map

families Eucleidæ and Megalopygidæ, with their extralimital relatives, the Dalceridæ and Aididæ, are closely related; the Zygænidæ and Pyro-



FIGS. 67–71. ZYGÆNOIDEA: EUCLEIDÆ

67, *Phobetron pithecium*, ♀, venation; **68,** *Adoneta spinuloides*, venation; **69,** *Euclea delphinii*, venation; **70,** *Prolimacodes scapha*, venation; **71,** *Packardia geminata*, venation

morpidæ form a second group, but the western and exotic family Epipyropidæ is not closely related to either, and in fact seems more closely connected with the Tineoidea.

The group is distinguished primarily by the larva (fig. 66) which has tubercles **i** and **ii** united into a single wart and likewise **iv** and **v**; but in most Eucleidæ these warts have been lost, and the body may be smooth. In the adult the venation is quite complete, including the base of media (not always forked) and the entire length of **1st A** in both wings. The maxillary palpi are rudimentary, and usually the tongue as well. In the Zygænidæ and Pyromorphidæ the tongue is strong. The wings are ample, of the macro type, with short fringes; the scaling sometimes soft, but fairly firm in the otherwise rather Yponomeutid-like Zygænidæ. The frenulum of the female is a tuft of many bristles.

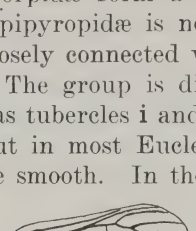


FIG. 72. ZYGÆNOIDEA: MEGALOPYGIDÆ
Lagoa crispata, venation

The egg is always of the flat type, and is very thin and wafer-like in the Eucleidæ (except the primitive genus Monoleuca). The larva is always more or less shortened and slug-like, with a retractile but large head. The hooks of the prolegs, when present, are in a single, uniordinal band. The two epicrania only unite for a very short distance above the front, leaving a large, triangular, or more narrow, slit-like space, filled with cervical membrane. Typically, the epicrania extend internally into the neck, as in leaf-miners. The pupa is of a low incomplete type, with thin skin and more or less movable appendages. Abdominal segments 3 to 6 are free, and 7 also in the male. The first abdominal spiracle is uncovered (as also in the Nepticulidæ). The maxillæ have a strong, lateral extension at the base, sometimes reaching the antennæ, but lack a separate maxillary palpus. In Lagoa the maxillæ are reduced and divergent, much like those of the Hepialidæ. The abdominal segments are armed with scattered spines. The cocoon is of silk, usually rather parchment-like, with a more or less specialized trap-door at the anterior end for the emergence of the pupa. The larva hibernates in the cocoon, pupating in the spring.

Family 6. **MEGALOPYGIDÆ**

(Lagoidæ; Liparidæ, in part)

(The flannel moths)

Closely similar to the Eucleidæ. Male, and sometimes female, antennæ pectinate to the tip; fore wing (fig. 72) with vestiture often crinkly, of more or less hairlike scales. Hind wing in our species with **Sc** and **R** fused most of the length of the cell, but free at base, unlike the North American Pyromorphidæ, in which also $\mathbf{R}_4$ and $\mathbf{R}_5$ of the fore wing are stalked. Mouth parts much reduced, and buried in dense hair.

Egg ellipsoidal. Larva with stinging hair mixed with dense, soft hair, arranged in diffuse tufts, ventrally with a few subprimaries only. Prolegs, without hooks present on abdominal segments 2 and 7, beside the normal ones on segments 3 and 6 and the last segment, which each have a uniordinal row of hooks, sharply angulated in the middle, or interrupted by a more or less distinct sucker. Pupa with all abdominal segments free (except the usual terminal ones). Appendages free. Maxillæ rudimentary, divergent, quadrangular as in the Hepialidæ, leaving the labial palpi wholly uncovered. Abdominal segments 2 to 6, inclusive, with conical tubercles behind the spiracles. Abdomen with fine, spinulated bands on anterior part of segments and a tuft of bristles on each side of dorsum behind them. Eyes and first spiracles as in the Eucleidæ.

This small family is almost wholly American.

Key to the genera

Hind wing with $\mathbf{M}_3$ and $\mathbf{Cu}_1$ stalked; white.....**Norape.**
Hind wing with $\mathbf{M}_3$ and $\mathbf{Cu}_1$ separate; cream or yellow.....**Megalopyge.**

1. *MEGALOPYGE* Hübner

(*Lagoa* Harris)

Fore wings with discolored, crinkly hair toward costa. Frenulum rudimentary. Caterpillar with hair from tufts rather long and spreading so as nearly to conceal the body.

Key to the species

1. Wholly orange ochre.....*pyxidifera.*
1. Crinkly hair in part contrasting, brown and black.
2. Thorax ochre yellow to brown.....*opercularis.*
2. Thorax cream color.....*crispata.*

I. *Male antennae half as long as fore wing, of female about a third as long as fore wing; cocoon with two transverse flanges on upper side.* (Megalopyge).

1. **M. opercularis** Smith and Abbot. Thorax and basal tuft of abdomen ochre;

crinkly hair, a mixture of light, chocolate brown and white, blackish on costa; outer margin yellow; fore legs blackish with white at apex of tibia. 25–35 mm. (**H 38**:25.)

Caterpillar with little, curled tufts on each side of tail.

The moth occurs normally from Maryland south. A stray has been found at Ithaca, New York.

II. *Male antennæ two-thirds as long as fore wing, female over one-third; cocoon oval; larva without curled tufts of hair at tail.* (Lagoa).

2. **M. pyxidifera** Smith and Abbot. Wholly ochre yellow. 25–35 mm. **H 38:41.**

Caterpillar grayish white when young, gray in last stage; on oak.

Southern States.

3. **M. crispata** Packard. Cream color; crinkly hair black and brown, most of it along the costa. Fore legs pale with black tips. 25–35 mm. **(H 38: 23).**

Caterpillar cream white when young, dull red shading into smoky gray in front in the last stage; on various shrubs and trees.

In aberration **grisea** Barnes and McDunnough, the ground color is mouse gray with a contrasting pale fringe.

Massachusetts and southward. New York: Onteora Mountain, New Baltimore, Bethlehem, Karner, Albany, Rhinebeck, Poughkeepsie, New Windsor, Katonah, Staten Island; Brooklyn, Woodhaven, and elsewhere, Long Island.

2. *NORAPE* Walker

(*Carama* Walker; *Lagoa*, subgenus *Ulosota* Grote)

Frenulum well developed.

1. **N. ovina** Sepp. Pure white, with a little crinkly hair. 30 mm. (*cretata* Grote, *pura* Butler). (**H38**:22.)

Larva with sparse tufts of hair and contrastingly spotted body, on Celtis.

District of Columbia and southward.

Family 7. **EUCLEIDÆ**

(Cochlidiidæ, Limacodidæ)

(The slug caterpillars)

Normally small, stumpy-winged moths with deep, often woolly vestiture. Head small and retracted, palpi fairly well developed, tongue and maxillary palpi much reduced. Thorax of low type, with metascutum narrowly continuous. Fore wing with two, and hind wing with three, completely preserved anals, base of media preserved, sometimes forked. Venation complete or nearly so; **Cu** 4-branched, $\mathbf{R}_3$, $\mathbf{R}_4$, and $\mathbf{R}_5$ stalked or united in fore wings; **Sc** and **R** in contact or fused for a short distance at or before middle of cell in hind wing, rarely merely connected by the apparent crossvein $\mathbf{R}_1$.

Egg of the flat type, very thin and waferlike except in Monoleuca. Larva slug-like, with the prolegs replaced by suckers. Head large but permanently concealed in the thorax, save for a slit in the under side of the prothorax to allow feeding; head lightly chitinized, the vertex cleft almost to the front. Labrum with **ii** much higher and smaller than **i**. Larvæ in primitive forms with long, hairy, more or less stiff lappets

or with strong spines provided with stinging hair, in the specialized forms with smooth bodies and practically all the hair lost. Thoracic legs present but small. Pupa of a low incomplete type, apparently with first abdominal segment free, as well as all appendages; diffuse spinulation all over dorsum of abdomen; collar projecting over head in a pair of subdorsal lobes, and mesoscutum extending back across metathorax to abdomen. Maxillæ with tongue-case extending along labial palpi, but not to their end, with a lateral projection at base, reaching in Prolimacodes under the eye to the antenna. Eye strongly sculptured, and forming a movable cap, covering end protecting the first spiracle, which is ventral, not dorsal as in most families.

The larva hibernates in the cocoon. The cocoon is oval, simple, and has a hinged lid for emergence.

There are about 400 species, the Phobetron group being American, the spined group, largely tropical in both hemispheres, and the group with smooth larvæ, north temperate.

Key to the genera (males)

1. Antennæ pectinate at base, with serrate or simple outer half.
   2. Fore wings lacking one vein (fig. 68).
      3. Outer margin regularly convex.....7. **Monoleuca**
      3. Outer margin concave below apex.....8. **Adoneta**
   2. Venation complete, with 10 veins arising from cell.
      3. Inner margin of fore wings somewhat sinuate.....4. **Sibine**
      3. Inner margin of fore wings evenly convex.
         4. Thorax green .....6. **Parasa**
         4. Thorax in our species brown.....5. **Euclea**
1. Antennæ pectinate nearly or quite to apex.
   2. Palpi reaching or exceeding vertex.....2. **Isochætes**
   2. Palpi not reaching vertex.
      3. Head strongly retracted, male smoky with translucent wings, wholly unlike female.....1. **Phobetron**
      3. Head fairly prominent, sexes similar.
         4. Hind tibiæ with terminal spurs only.....9. **Sisyrosea**
         4. Hind tibiæ with four spurs.....10. **Natada**
1. Antennæ serrate or simple.
   2. Hind tibiæ with terminal spurs only.....14. **Heterogenea**
   2. Hind tibiæ with four spurs.
      3. Palpi reaching beyond vertex.
         4. Palpi extremely long, with third joint more than half as long as second. 3. **Cnidocampa**
         4. Palpi reaching barely above vertex, third joint shorter..15. **Lithacodes**
      3. Palpi reaching barely to vertex, or shorter.
         4. Robust, with serrate antennæ.....11. **Prolimacodes**
         4. More slender, with simple or laminate antennæ.
            5. Fore wing with rounded apex, but oblique outer margin. 13. **Tortricidia**
            5. Fore wing with square apex and nearly straight costa. 12. **Cochlidion**
            5. Fore wing broad and bluntly rounded.....16. **Packardia**

Artificial key to species

1. Thorax green 2
1. Thorax brown or yellow 3
2. Hind wing half yellow and half brown ..... *P. chloris* (p. 108)
2. Hind wing nearly evenly colored, or with narrow brown border. *P. indetermina* (p. 107)
3. Fore wing marked with green 3½
3. Fore wings without green 4
3½. Fore wings with all veins preserved, apex bluntly rounded *E. delphinii* (p. 107)
3½. Fore wings with 11 veins, apex subfalcate ..... *A. spinuloides* (rarely) (p. 108)
4. Small; hind wings triangular, transparent except on inner margin. *P. pithecium* (p. 105)
4. Hind wings more rounded, heavily scaled 5
5. A large, subtriangular, dark brown area, resting on costa ..... *P. scapha* (p. 110)
5. No such costal patch 6
6. With ocellate spots at anal angle 7
6. No such spots 9
7. Spots at anal angle black, pale ringed ..... *P. elegans* (p. 112)
7. Spots pale, dark ringed 8
8. Hind wings paler than fore wings ..... *P. geminata* (p. 112)
8. Hind wings blackish ..... *P. albipunctata* (p. 113)
9. Marked with pure white 10
9. No pure white, rarely a straight, diffuse, whitish, median band 13
10. An irregular, transverse, median band ..... *L. fasciola* (p. 112)
10. Such a band on inner half of wing only 11
10. A minute streak on middle of inner margin and on costa before apex 12
10. Two subapical dots and a dot below cell only ..... *S. stimulea* (p. 106)
11. Band extending into cell ..... *M. semifascia* (p. 108)
11. Band sapping abruptly at Cu ..... *M. subdentosa* (p. 108)
12. Ground light ochreous ..... *A. bicaudata* (p. 108)
12. Ground red-brown ..... *A. spinuloides* (p. 108)
13. Base of fore wing lemon yellow, contrasting with the buff ground *C. flavescens* (p. 106)
13. Base of fore wing not contrastingly yellow 14
14. Fore wing straw yellow, contrasting with the dark brown hind wing; immaculate ..... *T. minuta* (p. 111)
14. Fore wing not contrastingly pale, or with complex markings 15
15. Hind tibiæ with end-spurs only 16
15. Hind tibiæ with 4 spurs 17
16. Expanse under 15 mm.; hind wing blackish ..... *H. shurtleffi* (p. 112)
16. Expanse over 15 mm.; hind wing chocolate brown ..... *S. textula* (p. 109)
17. Postmedial line distinct, wavy 18
17. Postmedial line even, or marks obsolescent 19
18. Palpi hardly exceeding front ..... *P. pithecium* (p. 105)
18. Palpi extending above vertex ..... *I. beutenmulleri* (p. 106)
19. A transverse band formed of brown, longitudinal striations on the veins. *T. testacea* (p. 111)
19. No longitudinal striations on veins 20
20. Subterminal line straight across apex, meeting outer margin above Cu_2 21
20. Subterminal line nearly straight, ending on inner margin; antemedial line similar, more oblique ..... *N. nasoni* (p. 109)
20. Subterminal line arcuate, running across apex, or markings obsolete 24
21. Subterminal line whitish, and cutting off a dark brown apical patch. *C. biguttata* (p. 110)
21. Subterminal line dark, the wing not dark beyond it 22

22. Antemedial line pale-shaded beyond; no median line parallel to it.....23
22. Ground color even, ochre, a median line from M_3 to inner margin, parallel to the antemidial line.....*C. y-inversa* (p. 110)
23. Hind wing blackish.....*C. rectilinea* (p. 110)
23. Hind wing straw yellow.....*C. latomia* (p. 110)
24. Clay color, markings obsolescent.....*T. pallida* (p. 111)
24. Fore wing orange, hind wing pale yellow, markings obsolescent. *T. flavula* (p. 111)
24. Yellow with well-marked, curved subterminal line.....25
25. Hind wing nearly black, contrasting with the fore wing....*T. fiskeana* (p. 111)
25. Hind wing concolorous with fore wing, or slightly paler.....26
26. Subterminal line filled below with brown, and whole median area brown in many specimens .....*T. cæsonia* (p. 111)
26. With the slightly diffuse lines only.....*T. flexuosa* (p. 111)

Tribe **Phobetrini**
(Tropic hairy type)

Larvæ hairy; subventral space somewhat reduced; with more or less deciduous, setose horns, the subdorsal one strong and laterals reduced; spiracle of first abdominal segment higher than the others, the tubercle above it absent; three tubercles on mesothorax. First stage single-haired, with tubercles **i** and **ii** united. Pupa not seen. Moth with antennæ pectinate to tip; R_2 stalked beyond the origin of R_5.

1. *PHOBETRON* Hübner

(*Economidea* Westwood; *Thyridopteryx*, in part, Packard; *Limacodes*, in part)

Body very stout, especially in male, and woolly; male antennæ with about 8 simple joints at apex. Fore wing of male triangular, the outer edge nearly straight, and fully as long as inner; hind wing with apex acute, outer margin strongly concave at middle, and anal angle lobed; wings translucent. Female (fig. 67) wings normal, hind wing proportionately small. Hind tibiæ short, stout, and tufted like the Euclea group, with the upper spurs weak.

The larva has an irregular and variable set of curved, detachable lateral processes, which are covered with fine stinging hair. These processes are detached before pupation and are woven into the cocoon. A few additional species occur in South America.

1. **P. pithecium** Smith and Abbot. Male translucent, smoky; veins and borders, especially inner margin of hind wing, smoky gray; with vague, darker, transverse bands. Female with wings opaque, the fore wing mixed light wood-brown, fuscous, and dull straw yellow, with a few blue scales, the border dark; postmedial line sinuous and scalloped; markings quite clean-cut. Hind wing dark. ♂ 20 mm. ♀ 25 mm. (*abbotana* Hübner, *T. nigricans* Packard, *hyalinus* and *tetradactylus* Walsh). (**H 47**:6 ♂, 7 ♀.)

The larva is a general feeder on shrubs. (**H. 1**:4).

Montreal, Quebec, and south. New York: Bolton (larvæ), Niagara Falls, Oswego, Lancaster, Bath, Hudson Valley, from Port Ewen south; Long Island.

2. *ISOCHÆTES* Dyar

(*Semyra,* in part)

Body relatively smaller; palpi much longer and smooth; hind tibiæ with end spurs only Venation as in female Phobetron. Caterpillar very fluffy, with all the subdorsal spines long.

1. **I. beutenmulleri** H. Edwards. Similar to female *pithecium;* markings less clean-cut, postmedial line not distinctly wavy; outer margin pale yellow; blue scales more prominent. 20 mm. (**H. 47**:17.)

The larva is green.

Staten Island, New York, to Florida.

Tribe **Eucleini**

(Tropic spined type)

Larvæ spiny, with subventral space reduced; tubercles tending to be horn-like, not deciduous, poisonous in several species; 2 tubercles on thoracic segments; first abdominal segment as before; first stage with several hairs to a tubercle. Antennæ of male moth normally pectinate with simple tip; hind tibiæ usually with end spurs only, palpi moderate, R_5 stalked, R_2 usually free. Pupa with lateral processes of maxillæ reaching to base of antennæ.

3. *CNIDOCAMPA* Dyar

(*Miresa*)

Palpi stout, very long, with second and third joints equal; male antennæ simple, laminate. Larva similar to Sibine but with rudimentary subdorsal spines on the middle segments, besides the long ones, and with a small, blue rectangle in place of the saddle-marking; feeding on Japanese Ivy (Ampelopsis).

1. **C. flavescens** Walker. Fore wing with outer half light fawn, with two oblique, brown lines; base lemon yellow, much more broadly on costa. 30 mm.

Boston, Massachusetts, introduced from Asia. Seldom injurious.

4. *SIBINE* Herrich-Schæffer

(*Empretia* Clemens)

Similar to Euclea, except for the sinuous inner margin. R_5 sometimes free but closely connate with R_{3+4}. Larva with strong anterior and posterior subdorsal spines, but in middle segments rudimentary ones only, or, in our species, none.

There are several other species in tropical South America.

1. **S. stimulea** Clemens (Saddle-back caterpillar). Shining, deep seal brown, shaded with blackish; with three white points. Hind wing paler. 30 mm. (**H 47**:9.)

Larva with characteristic green saddle, and with brown central patch; feeding on various trees. (**H 1**:6.)

Massachusetts to southern Illinois and southward. New York: Poughkeepsie Staten Island; Brooklyn, and Woodhaven, Long Island.

5. *EUCLEA* Hübner

(*Limacodes,* in part)

Antennæ of male closely pectinate about two-fifths way out, then strongly errate for a short distance, but with simple apical half; antennæ of female early simple. Palpi moderate, curved, and a little rough. Wings broad, all veins resent. Fore wing (fig. 69) with outer and basal part of inner margin strongly onvex. R_5 strongly, and R_2 often shortly, stalked.

Larva stout and prismatic, not much smaller in front, subdorsal and lateral pines irregularly but about equally developed; small pointed clusters of detachble spines between the terminal horns, the so-called caltrop spines.

The genus is not really distinct from Parasa, and *P. indetermina* is intermediate.

1. E. delphinii Boisduval. Brown, tending to shade into purplish brown and awny, more or less marked with green, the boundary often edged with white. 5–30 mm. (*cippus, querciola, tardigrada,* etc.)

The larva feeds on various trees and shrubs. The moth flies in June.

Montreal, Quebec to Illinois and southward. New York: Plattsburg, Peru. he typical form, with varieties *interjecta* Dyar and *viridiclava* Walker, is rather ommon southward. Variety *elliotii* Pearson is recorded from Big Indian Valley, loney Island, and Glendale, Long Island, and variety *pœnulata* Clemens is reported rom New York State by Packard.

The following varieties are recognized, one or two of which may prove, on reeding, to be distinct species.

Key to the varieties

. Dominantly brown, the cell brown.
2. One large irregular green patch.....*viridiclava* Walker (**H 47**:23).
2. Two green spots connected by a row of dots.....*interjecta* Dyar.
2. Two green spots only.
3. Lower spot, below base of cell, small and triangular; upper spot sometimes broken into separate dots.....*delphinii* (**H 47**:24).
3. Lower spot large and forked, or running out below cell.
querceti Herrich-Schæffer.
. Dominantly green, cell green.
2. A large, brown, discal spot.....*elliottii* Pearsall.
2. No discal spot.....*pœnulata* Clemens (**H 47**:5).

6. *PARASA* Moore

(*Euclea,* in part; *Callochlora* Packard)

Similar to Euclea, R_2 less frequently stalked; thorax green in our species. arva without caltrop spines.

1. P. indetermina Boisduval. Male antennæ merely serrate at middle. Vertex nd thorax green, underside brown; fore wing green, with a brown patch at base, nd a brown, slightly irregular border, about one-fifth as broad as length of wing, ormally with a darker shade at middle of outer margin. 25 mm. (*viridis* Reakirt, *ernata* Packard) (**H 47**:10 ♂, 15 ♀ as *chloris.*)

This species and *chloris* have been much confused and even interchanged, making ublished records uncertain. The caterpillar is not humped in front, and has rong spines on the second, fifth, and last segments of abdomen. The caterpillar

is red or yellow, purple, and white. It feeds on apple and many other trees and shrubs.

New York to Illinois and southward. New York: Staten Island, Woodhaven etc., Long Island.

2. **P. chloris** Herrich-Schæffer. Antennæ of male broadly pectinate rather beyond middle. Similar to *P. indeterminata*, smaller; the outer border generally broader and more even in outline, with the veins across it generally darker; no darker patch at middle. 20–25 mm. (*fraterna* Packard, *Neæra* Herrich-Schæffer.) (**H 47**:26 ♂ 29 ♀.)

The larva is strongly humped anteriorly, with much-reduced spines and a pointed tail. It is dead-leaf brown with a red, posterior patch.

Southern New York; and New Jersey to Western Pennsylvania. New York: New Windsor, Staten Island, Forest Park, Brooklyn.

7. *MONOLEUCA* Grote and Robinson

(*Limacodes*, in part)

Antennæ of male pectinate beyond middle, palpi like Euclea; fore wings evenly rounded, with R_3 and R_4 completely fused; R_2 stalked. Built slighter than Euclea. Larva with spines short and subequal, the lateral ones on first segment of abdomen missing, replaced by the spiracle, a pair of spines at each end of body somewhat longer than the others.

1. **M. semifascia** Walker. Fore wing red-brown with a narrow, somewhat wavy white fascia from about the middle of cell to inner margin. 20 mm.

The moth flies in July. The larva is vermilion red with two pairs of vermilion stripes edged with yellow, running along the rows of spines. There are also dorsal and lateral bands, each composed of three blue lines, and a subventral band of two lines.

M. subdentosa is probably found only south of our area.

8. *ADONETA* Clemens

Similar to Euclea. Fore wing (fig. 68) with outer margin slightly concave below apex, R_3 and R_4 united, stalked with R_5; R_2 free. Larva with short spines, without detachable caltrop spines between the terminal ones, spines on abdominal segments 2, 5, and 8 longer than those between, but all very small.

1. **A. spinuloides** Herrich-Schæffer. Fore wing brown, of various shades, tending to be darker, and generally also dark-shaded on the veins toward the margin. An irregular and broken dark postmedial line edged with white toward costa and inner margin, or (in a single specimen seen) with small green patches like *E. delphinii*. 20 mm. (**H. 47**:3).

The larva eats various shrubs. It is green, with a broad, irregular, purple dorsal band, and yellow subdorsals, the terminal spines short. The moth flies in July and August.

Montreal to Illinois, south to North Carolina. New York: Albany, New Windsor, Staten Island, Pinelawn, Yaphank, Long Island.

A. leucosigma Packard is probably a variety of this species in which the dark marginal shading is absent. It is reported from New York to Texas. I have seen no specimens from a definite locality in New York.

2. **A. bicaudata Dyar.** Ground color light yellow, the border diffusely and rather narrowly cinnamon brown. Markings as in *A. spinuloides*, but often without the dark discal bar. Larva with a pair of long spines at posterior end.

This form is known from the District of Columbia to North Carolina.

9. *SISYROSEA* Grote

(*Isa* Packard)

Male antennæ broadly pectinate to apex; antennæ of female simple. Palpi n male obliquely truncate, reacning middle of front, in female smaller. Hind ibiæ with end spurs only. Moth quite stout. Fore wing with outer margin ecidedly oblique, bent at middle, and slightly concave above, R_2 given off from adial stem at a sharp angle, beyond the origin of R_3. Surface of wing when per- ect, showing wavy scaling in transverse striæ, much as in the Megalopygidæ. The larva is strongly flattened. Its subdorsal spines are irregularly reduced, nd the lateral spines are very long, even, and feathery, and are held appressed o the surface on which the larva rests.

Sisyrosea is a primitive genus, in some ways transitional to the Phobetrini.

1. **S. textula** Herrich-Schæffer. Fore wing shaded pale gray, brownish, and ight flesh color. 20 mm. (*Limacodes inornata* Grote and Robinson.) (**H. 47**:14.) Larva green; feeding on wild cherry and many other shrubs.

Massachusetts to Pennsylvania. New York: General from Plattsburg south- ard. Larva more often seen than moth.

10. *NATADA* Walker

(*Sisyrosea,* in part)

Similar to the last genus; R_2 free, wings rounded, with marked apex; scaling ormal; tibiæ with four spurs. Larva high, prismatic, with short, subequal orns, and no caltrop spines.

1. **N. nasoni** Grote. Clay color, somewhat dusted with fuscous; with two oblique ark lines. 25 mm.

Larva green with yellow lines, and red tubercles; on oak and other trees.

The moth, though commoner in the southern States, seems rare. New York: onkonkoma and Yaphank, Long Island.

Tribe **Cochlidiini**

(Smooth Eucleids)

Larva without tubercles or spines after first stage, spiracle of first bdominal segment normal, and its lateral tubercle present. Pupa with axilla not extending out to antennæ. Moth with R_5 free, usually rising about half way between R_{3+4} and M_1; usually with all spurs n hind tibia.

11. *PROLIMACODES* Schaus

(*Limacodes; Eulimacodes* Dyar, not Möschler)

Stouter than the following genera; male antennæ serrate; **R** and M_1 of hind ing normally stalked (fig. 70). Larva with broad dorsal and subventral areas eeting in a sharp ridge, but without lateral area; in first stage with 2-haired arts.

An aberrant genus representing a typically South American group, the "tropic smooth type" of Dyar.

1. **P. scapha** Harris. Fore wing with a large triangular, deep brown area extend ing from a quarter way out on costa to apex, and down to **A**, with a narrow extension along costa to base; rest of wing pale brown, becoming silvery towar the dark brown patch. 25 mm. (**H 47**:8.)

The moth appears in July and August. Florida and Arizona specimens repre sent very distinct races (**argentimacula** Barnes and McDunnough and **trigona** H. Edwards). The larva is green, brown, and yellow, and lives on various trees and shrubs.

New York to Florida and Arizona. New York: Geneva, Ithaca, Florida, Rhine beck, Staten Island; Brooklyn, East New York, Newtown, etc., Long Island. Judg ing from the larvæ seen, the species will prove much wider-spread.

12. *COCHLIDION* Hübner

(*Limacodes* Latreille)

In this and the following genera, the male antennæ are simple and laminate **R** and $\mathbf{M}_1$ of the hind wing are normally free. In the larva, the dorsal and latera areas are equally broad, and the subventral area reduced. The first stage ha simple setæ. They are the "palæarctic smooth type" of Dyar.

Moth of Cochlidion with palpi upturned to about the middle of the front longest in *C. biguttata*. Vestiture composed of hair and narrow spatulate hair Hind tibiæ with all spurs, less heavily fringed than in Prolimacodes, but mor than in some of the later genera. Fore wing with apex rectangular; outer par of costa and upper part of outer margin straight; all veins present; $\mathbf{R}_2$ and R both free, but approximate. Larva with small, but sharp, depressed spaces; with posterior end not extended. Skin spinulated. In the first stage setæ **i** and **ii** ar very unequal, on the same wart.

1. **C. biguttata** Packard. Very pale gray, base and anal and apical spots woo brown, pale-edged, postmedial line nearly straight. 25–30 mm. (*Limacode* Packard.)

June and July.

The larva has been found on oak only. It is pale whitish green, with a whit sub-dorsal line, edged with dark, and no transverse yellow line on anterior margi of thorax.

Montreal, Quebec to New York and Illinois. New York: Plattsburg, Ithaca Ronkonkoma and Yaphank, Long Island.

2. **C. rectilinea** Grote and Robinson. Yellowish or reddish brown, the media area rather grayer, with base darker; antemedial line white, preceded by a dar line; lines across apex and at anal angle straighter, and not cutting off wel marked dark patches. Hind wing rather darker gray-brown. Over 20 mm.

The moth occurs in the South, perhaps not ranging as far north as Virginia northern records being based on *C. latomia*.

New York: reported in the vicinity of New York (Beutenmuller, Grote, an Robinson).

3. **C. latomia** Harvey. Similar to *C. rectilinea*, but with paler fore wing an pale, straw-yellow hind wing, no distinct spot at anal angle, and only a sligh dark shade before the antemedial line. (**H 47**:27.)

New York to Texas; commoner southward.

4. **C. y-inversa** Packard. Dull light ocherous, with pale or dark shades; line dark, even, sharply defined; antemedial from middle of costa to inner margi at a third way out; a second line, parallel to it, below middle of wing; a lin across apex, and dark fringe; hind wing yellow. 25 mm.

Larva on hickory and blue beech; similar to *C. biguttata*, but with a yellow line across mesothorax.

Florida specimens belong to the variety **parallela**. Moth in July.

Gaspé, Quebec, to Illinois and Florida. New York: Batavia, Lewiston, Buffalo, Ithaca, Big Indian Valley, Poughkeepsie, New Windsor, New York City, Staten Island, Long Island.

13. *TORTRICIDIA* Packard

(*Heterogenea*, in part, etc.)

Palpi obliquely upturned to well beyond middle of front; fore wing with outer margin strongly oblique, apex rounded, costa more arched, and inner margin less sinuous than in Cochlidion. Larva with depressed spaces large and sharp; skin granulated but not spinulated; marked with red dorsally. In first stage, with setæ i and ii equal.

Kronæa minuta probably belongs to this genus or to Heterogenea.

1. **T. fiskeana** Dyar. Fore wing tawny yellow, with a straight, oblique median line, sharply defined on its inner side, and a strongly curved one across the apex, the space between them sometimes more or less filled with brown. Hind wing nearly black. 14–15 mm.

This form is perhaps a variety of *minuta*. The lines are less diffuse than in *Heterogenea shurtleffi*.

Durham, New Hampshire; Iowa.

2. **T. flexuosa** Grote. Similar to *T. fiskeana*, both wings pale yellow, the lines not suffused. 15–25 mm.

In variety **cæsonia** Grote (**H 47**:12) the medial area is suffused with brown. Larva green with yellow subdorsal lines; the red dorsal markings, when extended laterally in cross form, not reaching more than halfway to the lateral margins; sometimes reduced to one or two spots.

Quebec to New Jersey and western Pennsylvania. New York: Ithaca, De Bruce, Big Indian Valley, Onteora Mountain, Ilion, Sharon Springs, Rhinebeck, Poughkeepsie, Windsor, Bronx Park, New York City, Long Island.

The dark form **cæsonia** Grote, is known from Big Indian Valley, Coeymans, and Poughkeepsie.

3. **T. pallida** Herrich-Schæffer. Fore wing light pinkish brown; hind wing straw yellow, typically immaculate, in var. **flavula** Herrich-Schæffer showing traces of lines. 10–18 mm.

The larva occurs on willow oak, and other shrubs. It is green, with the usual two subdorsal yellow lines, with a large, red, cross-shaped mark extending from end to end of the body, and from side to side at the middle, the anterior arm of the cross narrow, but the posterior widening into a patch. The moth flies in July.

Southern Maine to southern New York; probably more widespread but overlooked. New York: Plattsburg, Keene Valley, Ithaca, Staten Island; Brooklyn, and Bellport, Long Island.

4. **T. testacea** Packard. Dull, light brown with a broad, dark, median shade, darkest along the veins. Hind wings paler. 15 mm. (**H 47**:11.)

Larva with the dorsal red patch as long and wide as the body, but symmetrical from front to back; feeding on oak, birch, wild cherry, and so forth.

Nova Scotia to northern New Jersey and Illinois. New York: Plattsburg, Saranac Lake, Red Lake, Ithaca, McLean, Big Indian Valley, Staten Island; Merrick, Long Island.

5. **T? (Kronæa) minuta.** Fore wings straw yellow, hind wings blackish, immaculate 10 mm.

Larva with yellow line across the front of the thorax and a larger red patch than in *H. shurtleffi*.

Atlantic States. The type is lost, and no other specimens are known to exist.

14. *HETEROGENEA* Knoch

Similar to Tortricidia, but with upper spurs of hind tibia lost, and palpi weaker, hardly reaching the middle of the front.

1. **H. shurtleffi** Packard. Base of wings rusty, outer part brown, obscuring the markings, which are brown, and much as in *C. y-inversa*. 12 mm. (**H 47**:20.)

This species is apparently rare. The larva is similar to the Tortricidias, but has a transverse yellow line across the mesothorax, and only a small red dot in the middle of the dorsum.

Massachusetts to New Jersey. New York: Vicinity of New York City (Eliot and Angus).

15. *LITHACODES* Packard

Similar to Packardia; palpi upturned beyond vertex, or, when obliquely held, projecting strongly, and reaching level of antennæ. Larva similar to that of Cochlidion, but with a mixture of granules and spinules on the skin.

1. **L. fasciola** Herrich-Schæffer. Ochre yellow with a white, irregular, transverse, median band, usually followed by a deep brown shade; rarely all brown except the terminal area, and with the white bands strongly contrasting. 20 mm. (**H 47**:2).

Larva with a yellow subdorsal line, but no dark one, and no red markings. Moth in July.

Common generally; Quebec to Texas. New York: Buffalo, Geneva, Ithaca, Schenectady, and the southern Catskills.

16. *PACKARDIA* Grote and Robinson

(*Cyrtosia* Packard, not Perris)

Slender moths with scaly vestiture. Antennæ simple; palpi upturned beyond middle of front, acute; tibiæ with all spurs. Fore wing (fig. 71) with arched costa, bluntly rounded apex and outer margin, R_5 arising from end of cell nearly midway between R_{3+4} and M_1, R_2 arising from cell.

Larva with depressed spaces small; end of body produced in a pointed tail; skin granular and not spinose nor crested at any stage; no dorsal markings. First stage with tubercles i and ii represented by simple, short spines.

1. **P. elegans** Packard. Typically dark bronze-gray (in var. **fusca** Packard light buff) with a white band across end of wing to just above anal angle, and two lesser pale bands to middle of inner margin; ground more or less dark-shaded (The two black dots at the anal angle replaced by a vague dark shade in var. *fusca*.) 20 mm. (**H 47**:16.)

Moth in June and July. Larva translucent yellowish green, with a broken yellow subdorsal line and scattered patches of whitish green pigment. It feeds on the thin, shaded leaves of trees in dense woods.

Southern Quebec to northern New York. New York: Goat Island, Ithaca, Newburgh, New Windsor, Katonah, New York City, Long Island.

2. **P. geminata** Packard. Light straw or cream color, shaded with brown, except at base and beyond the outer line, which runs as in *P. elegans*. Antemedial line oblique and far out. Hind wings nearly concolorous. 25 mm. (**H 47**:1.)

The moth occurs in June. The caterpillar is densely pigmented, whitish green with a nearly white, subdorsal line. It is found on very small shrubs only a few inches high, especially on wild cherry. The female moth, unlike most Eucleids, will often wait a few days for fertilization before flying.

Southern Quebec to New York and Wisconsin. New York: Forest Park, Brooklyn.

3. **P. albipunctata** Packard. Similar to *P. geminata* but with blackish hind wings. Fore wings typically much shaded with brown and ochre, but in var. **ocellata** Grote as in *geminata*. 25 mm.

Larva unknown.

The moth occurs in New York (Karner, Dutchess County) but its general distribution is unknown; it is probably confused with *P. geminata*, of which it may be a Mendelian form.

Family 8. PYROMORPHIDÆ

(Zygænidæ, Anthroceridæ in part; Sphingidæ, in part, of early workers)

Moderately small moths, with smoky, translucent wings, in a few species with metallic coloring. Male antennæ generally thickened and shortly pectinate; head prominent, with small palpi and small or rudimentary maxillary palpi, but a strong, naked tongue. Ocelli present, well separated from eyes, sometimes very small. Fore wing (figs. 62 to 65) rounded with two fully developed anals, traces of base of media preserved, but not forked; no accessory cell; all veins except R_2 to R_5 inclusive arising separately from the cell. Hind wings with **Sc** and **R** fused beyond middle of cell, the basal part of **R** lost, or represented by a short spur, so that **Sc** seems to spring from the outer part of the cell; **Sc** much swollen or forked at base. (In the true Zygænidæ or Anthroceridæ, **Sc** and **R** are not fused, but are connected by a cross vein.) Hind wing with **1st A** preserved, but **3d A** lost in a couple of genera.

Egg of flat type. Labrum of larva with seta **ii** higher than **i** but not reduced; body with somewhat diffuse tufts representing warts **i+ii, iii, iv+v** and **vi**, with two tufts representing **vii**, but with **viii** simple; hairs serrate, but not feathery as in some Arctiids. Prolegs with hooks in a straight, uniordinal band, without any additional prolegs or suckers. Pupa incomplete but without motion between appendages; third to seventh abdominal segments free, and eighth in male also free from seventh. Tongue of macro type, reaching well toward tips of wings, and covering labial palpi, tongue laterally extended at base, but without a tooth to represent the maxillary palpi. Abdomen diffusely spinulated above.

A small and wholly American family, of about 50 species.

Key to the genera

1. Fore wing with nine veins from cell, all separate.....1. **Acoloithus.**
1. Fore wing with R_3 and R_4 stalked together, sometimes with 10 veins arising from cell.
2. Hind wing with about same area as fore wing, with 3 anals 2. **Pyromorpha.**
2. Hind wing very small, with 2 anals only.....3. **Harrisina.**

1. *ACOLOITHUS* Clemens

(*Harrisina*, in part)

Wings bluntly rounded and somewhat translucent, hardly reaching end of abdomen. Fore wing (fig. 63) with 4 radials, all arising separately from cell, hind wing with base of **R** represented by a spur in cell; M_1 lost; 3 anals; anal angle slightly lobed. Caterpillar with inconspicuous hair, with a broad dark lateral line; found on grape and ampelopsis.

1. **A. falsarius** Clemens. Black with orange collar. 16–18 mm. (*sanborni* Packard) (**H 16**:14).

The moth may be found on flowers in May and June.

New York to Louisiana, Florida, and Texas. New York: Syracuse, Ithaca, Rhinebeck, Crugers; Centerport and Lake Ronkonkoma, Long Island.

2. *PYROMORPHA* Herrich-Schæffer

(*Malthaca* Clemens)

Wings (fig. 62) bluntly rounded, hind wing larger than in Acoloithus, usually extending well beyond end of abdomen; female with wings very slightly reduced. Fore wing with all veins preserved, R_3 and R_4 stalked; hind wing with all veins; base of **R** lost. Wings very thin, with hair-scales. Larva with inconspicuous hair, dark, checkered with pale patches; on dead oak leaves.

1. **P. dimidiata** Herrich-Schæffer. Smoky; basal half of fore wings except on inner margin, and costal edge of hind wings, pale tawny, the tawny less extensive in female. 25 mm. (*Malthaca perlucidula* Clemens). (**H 47**:33 ♂.)

The moth flies from the end of May to July.

New York to Florida; also reported from the Western States. New York: Coy Glen (Ithaca), Staten Island, Brooklyn.

3. *HARRISINA* Packard

(*Aglaope; Procris*)

Fore wings four times as long as wide, outer and inner margins equal; R_2 stalked, but R_5 arising from cell, and widely separated from R_{2+3+4}. Hind wing of less than half the area of the fore wing, with M_1 and **3d A** lost. Wings more heavily scaled than in other genera.

Caterpillar with black tufts contrasting with the pale ground; social on grape.

1. **H. americana** Guérin. Black, slightly greenish iridescent, with orange collar. *Fore wing with vein* R_3 *lost* (fig. 65). 18–25 mm. (**H.** p. 372 f. 210.)

The larva is nearly white, with the black markings confined to the tufts. The moth flies from May to August. Perhaps the species has a wider distribution, but it has always been confused with *H. texana*.

Massachusetts to Virginia. New York: Troy, Poughkeepsie, Staten Island.

2. **H. texana** Stretch. Similar to *H. americana*, but with all veins preserved, R_2, R_3 and R_4 stalked (fig. 64). 20–28 mm. (**H. 43**:34 as *americana*.)

Larva with black transverse bands, sometimes broken, and a reddish lateral band.

New York to Texas. New York: Poughkeepsie; Woodhaven and Yaphank, Long Island.

The southwestern variety **australis** Stretch, which has been taken in Florida and Georgia, has orange on the base of the tegulæ, as well as on the collar.

SUPERFAMILY **TINEOIDEA** (restricted)

The Tineoidea, as represented by the typical Tineidæ, are hardly distinguished from the Adeloidea, save by the general loss of aculeæ on the wing surface. In a few genera, as in Solenobia and Opostega, a few aculeæ are still to be found about the base of the cell and along the veins. I think I have also seen a few in Tischeria and Setomorpha, but they are not present on the general wing surface. Another rather general character for the genera of this series, which are otherwise closest to the Incurvarioidea, is that the antenna is regularly provided with two whorls of scales to a segment, one whorl being of sharply outstanding scales, thus making the antenna rough and annulate (figs. 87 to 89). This character holds in Tinea and the genera reduced from it, but fails in most of the aberrant forms, in which the scaling is smooth and sometimes in more than two rows (Acrolophus, Psychidæ). The more primitive forms of Tineoidea are often case-bearers, but the lenticular case typical of the Adeloids is rare.

The moths of the Tineoidea have the vestiture of the vertex variable, though always rough in the lower forms; and there is no naked area above the eye. The eyes are often small. The ocelli are variable, and, when present, are as a rule near the edge of the eye. The tongue, when present, is scaled at the base. The labial palpi typically are long and folded, but often reduced, or lost. In the Gracilariidæ, which may not really belong of this superfamily, they are porrect. The primitive forms have a complete primitive venation (fig. 19), the base of **1st A** fading out; in higher forms, it is much reduced. In the hind wing, **R**, as a rule, is closely parallel to **Sc** at the base, and they are connected by a cross vein, ($\mathbf{R}_1$) a short distance from the base. The cross vein and the base of **R** often faded out together, but the cross vein is never preserved when **Rs** is weak, as in the Incurvariidæ. The Lyonetiidæ are an exception. The venation is sometimes extremely reduced, but **1st A** is preserved as long as **2d A**. The female has no piercing ovipositor.

The eggs are of the flat type. The pupa is incomplete. In the larva, setæ **iv** and **v** are usually widely separated (figs. 91, 92) as in the Noctuidæ, but there are three setæ on the prespiracular wart.

The Tineoidea and the next four superfamilies have been somewhat tentatively delimited and are not sharply defined, but the groupings here made will roughly indicate the relationships of the families. This superfamily, with the next three and the Incurvarioidea, forms the Tineid series as usually understood.

The Psychidæ have been widely separated by most workers, but there is little besides the egg-laying habit to distinguish them from the true Tineidæ; some have winged females (as in the case of Kearfottia, in

the United States), but in some the female is more reduced than in any other known form of Lepidoptera, and never leaves the cocoon.

Family 9. **TINEIDÆ** (somewhat restricted)

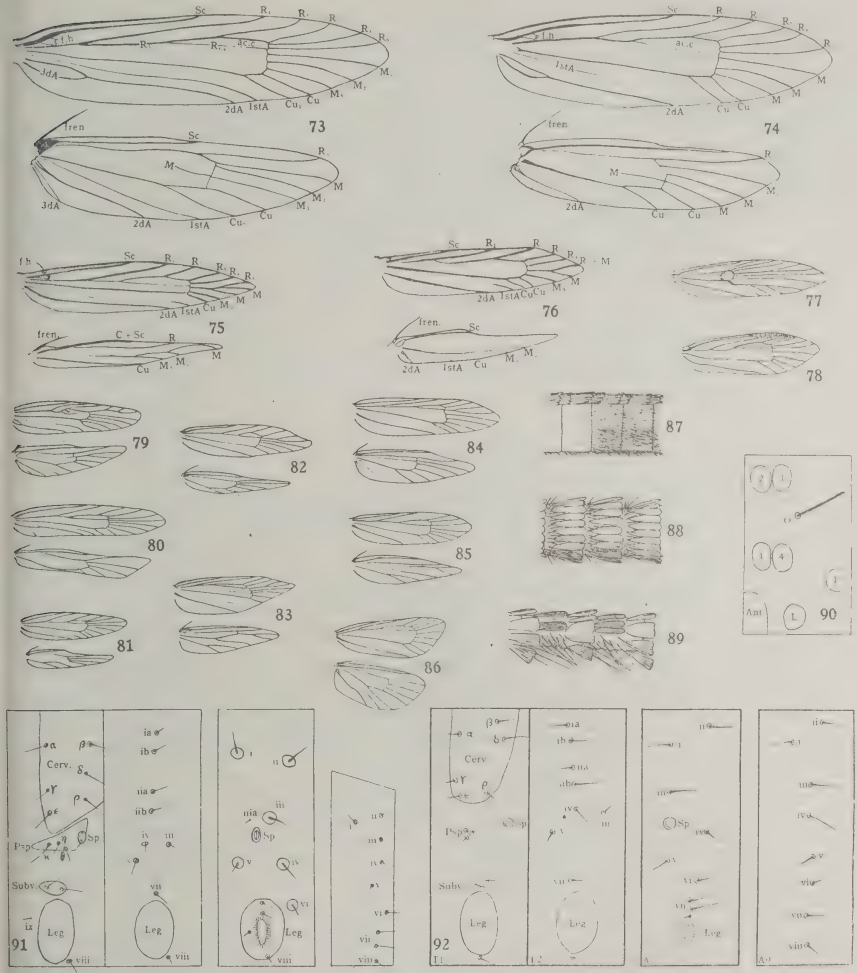
Head usually with high, rough, bristling vestiture; the vestiture finer and more macro-like in Acrolophus, and short in a few genera near Amydria which have a strongly bristled palpus. Front often rough and palpus often bristled on side, though but weakly in reduced forms and not at all in Acrolophus. Maxillary palpus typically five-jointed, folded, sometimes reduced or absent; tongue scaled, or rarely absent; antenna never much longer than wing, but usually more than half as long; often with a pecten, but without an eye-cap; typically with two whorls of scales to a joint, one of them of divergent scales (in Acrolophus the antenna is smooth-scaled, with several rows to a segment); antenna in our species simple, but pectinate in a few exotic Acrolophinæ. Fore wing with all veins, or with one vein absent; accessory cell usually present, separated from cell by a long, weak vein; base of media present in lower forms; **2d A** frequently forked at base; wing always rather narrow and sometimes lanceolate; hind wing varying from ample (Acrolophus) to linear (fig. 81); when broad, with **R** and $\mathbf{M}_1$ well separated, but in some genera $\mathbf{M}_1$ and $\mathbf{M}_2$ stalked; when narrow, often with an open cell; with most veins present, but frequently extremely weak. No aculeæ. Hind tibia usually with a mixture of bristles and hair, never smooth-scaled.

Egg of flat type, oval. Larva with setæ **iv** and **v** well separated, otherwise differing in the two subfamilies. Pupa incomplete, with well-marked maxillary palpus; with Adelid prothorax; abdomen with segments 4 to 7 inclusive, free, and 8 in male; but segment 2 fixed; each segment with a single anterior row of spines; tongue shorter than labial palpus.

The Tineidæ appear to furnish the point of origin of each of the higher tineoid superfamilies, and possibly of the macros as well, but the macros seem a little closer to the Yponomeutoids. The two subfamilies are not closely related, and could well be treated as families, as they often are.

Key to the genera of Tineidæ and Adelidæ

1. Vestiture deep and spatulate on thorax, with well-marked anterior and posterior tufts; palpus also with deep vestiture, not bristled (Acrolophinæ) **1. Acrolophus.**
1. Vestiture mainly scaly, except on head; palpus small, usually bristled.
   2. Only three short veins from cell to dorsal margin (fig. 106). Tischeria (Tischeriidæ) (p. 145).
   2. At least four veins from cell to dorsal margin.....(Tineinæ).
      3. $\mathbf{R}_3$ to $\mathbf{R}_5$ stalked (fig. 79); with a fovea in cell.....**20. Setomorpha.**
      3. $\mathbf{R}_3$ free.



FIGS. 73–92. TINEIDÆ

73, *Tinea pellionella,* venation; **74,** *T. granella,* venation; **75,** *Œnoë hybromella,* venation; **76,** *Homostinea curvilineella,* venation; **77,** *Monopis rusticella,* venation of fore wing; **78,** *Trichophaga tapetzella,* venation of fore wing; **79,** *Setomorpha insectella* ♀, venation; **80,** *Homosetia costisignella,* venation; **81,** *Leucomele miriamella,* venation; **82,** *Diachorisia velatella,* venation; **83,** *Hybroma chrysocomella,* venation; **84,** *Isocorypha mediostriatella,* venation; **85,** *Hybroma serrulella,* venation; **86,** *Choropleca vesaliella,* venation; **87,** *Acrolophus arcanellus,* male antenna, side view; **88,** *Tinea,* first group (Amydria and the rest are similar); **89,** *Cyane visaliella,* male antenna; **90,** *Tinea granella,* ocellar group of larva (typical of the subfamily); **91,** *Acrolophus arcanellus,* seta map (after Fracker); **92,** *Scardia fiskeella,* seta map (after Fracker)

4. Second joint of palpus with a bushy mass of scales below, more or less rounded in side view and very large; third joint long.
5. Antenna without a pecten; tuft nearly spherical; maxillary palpus porrect; vertex nearly smooth.....19. **Amydria.**
5. Antenna with a pecten.
6. Tuft less developed; maxillary palpus small but distinctly folded.
7. Tuft compact and triangular; wings with all veins arising separately .....2. **Scardia.**
7. Tuft of loose spatulate hair.
8. Hind wing with all veins free (figs. 73, 74)..4. A few **Tinea**
8. Hind wing with M_1 and M_2 stalked.....3. **Elatobia**
6. Tuft and maxillary palpus like Amydria; vertex with high, bristling vestiture. Fore wing with small, raised scale tufts.
18. **Xylesthia.**

4. Second joint merely rough-scaled; third joint often short; palpus often drooping.
5. Maxillary palpus, and usually tongue, obsolete.
6. Fore wing with ten veins arising from cell.
7. Antenna longer than fore wing.
(**Adela** and **Nemotois**-Adelidæ) (p. 77)
7. Antenna shorter than fore wing.....7. **Tineola.**
6. Fore wing with a radial lost; wings lanceolate.....8. **Tenaga.**[12]
5. Maxillary palpus developed, folded.
6. Fore wing with complete venation (ten veins arising from cell).
7. M_3 and Cu_1 of fore wing stalked, sometimes Cu_2 also (fig. 77).
6. **Monopis.**
7. M_1 and M_2 arising out of R_5.....14. **Homostinea.**
7. With only R_4 and R_5 stalked, or all veins free.
8. Tips of R_1 to R_3 fusing to form a stigma, with a thickened lower edge (fig. 78).....5. **Trichophaga.**
8. No stigma.
9. Cell of hind wing open above **Cu**; venation incomplete (fig. 85).
10. Antenna nearly as long as fore wing....17. **Triptodema.**
10. Antenna two-thirds as long as fore wing.
11. Hind wing broad-lanceolate, with convex costa and separate medial stem.....12. **Hybroma.**
11. Hind wing narrow, with sinuous costa, and **M** associated with **R**-stem (fig. 81).....13. **Leucomele.**
9. Hind wing ample, trapezoidal, with closed cell, but one medial lost (fig. 86).....11. **Choropleca.**
9. Hind wing normal, with all veins preserved (six arising from cell).
10. **A** of fore wing simple at base (fig. 82).
11. Fore wing smooth-scaled; Cu_2 of hind wing more than half as long as width of wing (fig. 84)..9. **Isocorypha.**
11. Fore wing more or less distinctly tufted; **Cu** of hind wing very short (fig. 82).....10. **Diachorisia.**
10. **A** of fore wing forked at base.
11. Each segment of antenna with a whorl of raised scales (fig. 88); fore wing with R_2 and Cu_2 well back from end of cell.....4. **Tinea.**

[12] Selenobia, with broad, bluntly rounded wings, likely to run out here (Psychidæ p. 143).

11. Antenna smoothly scaled or hairy; fore wing with R_2 and Cu_2 nearer end of cell (**Prodoxus, Tegeticula, Incurvaria;** — Adelidæ).

6. Fore wing with one vein lost.
7. M_1 and M_2 stalked with R_5 (fig. 75).....15. **Œnoë.**
7. M_2 stalked with R_5; M_1 lost (fig. 76).....14. **Homostinea.**
7. M_1 and M_2 stalked with R_5 (fig. 75).....15. *Œnoë.*
7. M_2 stalked with R_5; M_1 lost (fig. 76).....14. **Homostinea.**
8. Hind wing with 7 veins (counting the anals as one, as usual); cell ope nabove **Cu** (fig. 45).....(**Eudarcia,** Adelidæ) (p. 77)
8. Hind wing with normal venation.
9. **A** of fore wing forked at base (**Paraclemensia,** Adelidæ) (p. 76)
9. **A** of fore wing simple at base.
10. Hind wing linear, with sinuate costa. 12. **Hybroma** in part.
10. Hind wing linear, with sinuate costa. 10. **Diachorisia** in part.

Subfamily **ACROLOPHINÆ**

(Anaphorinæ; Psychidæ, in part, of Kirby and Tutt)

Head retracted; eyes medium-sized, usually hairy; ocelli absent; palpus large, with the first joint large, upturned to the middle of the front, and, in the western genus Eulepiste, as long as the other two together; the palpus as a whole often upturned to vertex, or even far beyond, especially in the male; in the female, typically porrect and shorter. Maxilla obsolete. Antenna with somewhat globular scape; the shaft smoothly scaled above, sometimes in more than two rows, and finely pubescent with sense hairs below; in male, laminate, rarely pectinate. Vestiture of head, including palpi, thorax and femora, rough, but fine and very dense, largely of spatulate hair; abdomen also rather hairy; R_5 of fore wing running to outer margin. Hind tibia hairy rather than bristled.

Larva (fig. 91) with front reaching only halfway to vertex, the adfrontals very wide and reaching vertex; ocelli six, but not regularly arranged, the fourth and lower being much closer together than the second and third are; head ventrally chitinized behind labium. Leg with trochanter one-third as wide as femur; prothoracic legs separated by a distinct, chitinized sternum; thorax with setæ on large shields; tubercles iii to v apparently taking the place of pleural sclerites; cervical shield extending the whole width of the prothorax and enclosing the spiracle; prolegs with one complete ellipse of hooks, preceded by several (3–6) rows of rudimentary ones; the anal proleg with a curved band.

The larva of one species is known to live in a tube near the surface of the ground, feeding on grass and the like, and pupating in the ground.

Pupa heavily chitinized, suited for coming up through the earth; antenna shorter than fore wing; fore wing bluntly rounded.

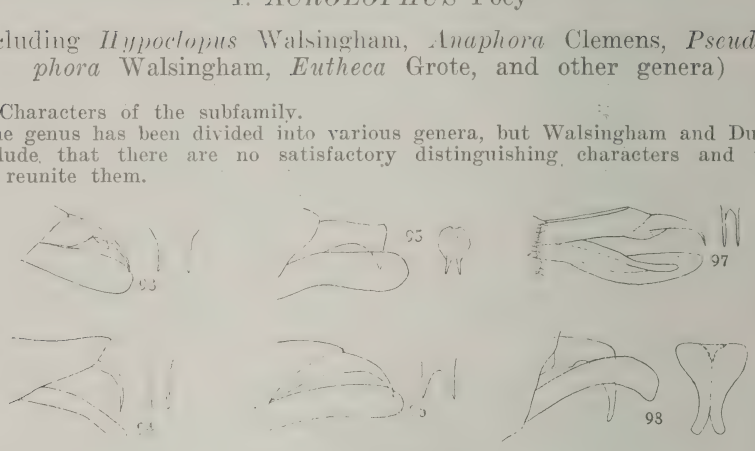
This group is entirely American, and predominantly tropical. Besides Acrolophus there are a couple of other well-defined genera.

1. *ACROLOPHUS* Poey

(Including *Hypoclopus* Walsingham, *Anaphora* Clemens, *Pseudanaphora* Walsingham, *Eutheca* Grote, and other genera)

Characters of the subfamily.

The genus has been divided into various genera, but Walsingham and Durrant conclude that there are no satisfactory distinguishing characters and therefore reunite them.



FIGS. 93–98. MALE GENITALIA OF SPECIES OF ACROLOPHUS

In each case the lateral view is shown, as seen after removing the scales. The dorsal view of the uncus is also shown. **93,** *A. arcanellus;* **94,** *A. mora;* **95,** *A. popeanellus;* **96,** *A. texanellus;* **97,** *A. plumifrontellus;* **98,** *A. mortipennellus*

Key to the species (males)

1. Uncus simple ..... 10. *griseus.*
1. Uncus bifid.
2. Valve with a lateral piece, overlying it, two-thirds as long as the main part of the valve (fig. 97) ..... 9. *plumifrontellus.*
2. Valve apparently simple in side view.
3. Valve strongly down-curved in side view; tips of uncus enlarged and rounded (fig. 98) ..... 8. *mortipennellus.*
3. Valve straight in side view; tips of uncus not enlarged.
4. Dorsal edge of uncus sharply bent at a right angle near middle (fig. 95).
5. Valve two-thirds as wide as length of vertical part of uncus (fig. 95). 3. *popeanellus.*
5. Valve fully as wide as length of vertical part of uncus..4. *confusellus.*
4. Dorsal edge of uncus evenly curved.
5. Spines of uncus fully one-third as long as valve, slender, separated by one-third their length; eyes naked (fig. 94) ..... 1. *mora.*
5. Spines of uncus less than one-third as long as valve or widely separated.
6. Body stout; palpus upturned, reaching just above the vertex (fig. 93) ..... 2. *arcanellus.*
6. Body more slender; palpus turned back over the vertex to the thorax.
7. Valve in the form of a large spoon, very wide and one-third as deep as wide ..... 5. *tenuis.*
7. Valve narrow and slightly spatulate (fig. 96) ..... 6. *texanellus.*
7. Valve slender and regularly tapering toward apex....7. *hulstellus.*

I. *Body rather slender; palpus of male extending back over middle of thorax or beyond; in female short and porrect; antenna of male as in Pseudanaphora or narrower, and subserrate; fore wing more pointed, that of male being about like that of female arcanella. Eyes naked.* (Sapinella *Kirby*, Eutheca *Grote, not Keisenw*).

1. **A. mora** Grote. Male blackish; female usually dull ochre yellow, or, rarely, ıll brown and obscurely mottled; a dark bar at middle of fold, and a slight rk spot at end of cell. Male (fig. 94) with branches of uncus long, slender, ıd parallel, not tapering to the bluntly rounded tip; valves also slender and of en width. 25–30 mm. (*arcanella* of authors).

The moth flies in October and November. The larva has been bred from birch Pearsall. The egg is long, narrow, and strongly ridged.

Concord, Massachusetts to North Carolina, and western Pennsylvania.

II. *Body stout, and, with vestiture, more than one-third as wide as length of fore wing; palpus upturned to just beyond vertex, but not extending back over thorax in male; palpus of female short and porrect; antenna smooth, and, in male, with laminations one-half wider than length of segments; eyes hairy.* (Pseudanaphora *Walsingham*).

2. **A. arcanellus** Clemens. Pattern and colors same as those of *A. popeanellus*; ıugh, black, raised striations on fore wing; spatulate vestiture on thorax much ıarser than that of *A. popeanellus*; wing of female rather longer and more pointed ıan that of *A. popeanellus*. (Fig. 93.) 25–28 mm.

The larva and pupa are described under the genus. The larva has been bred ı corn. The moth flies in late June and July.

I have seen the moth from New York, New Jersey, western Pennsylvania, and llinois.

III. *Male antenna with laminations as long as, or even longer than, wide; palpus as in Sapinella, or even longer, extending well beyond thorax in male, short in female; wings blunt; vestiture of fine, flattened hair; eyes hairy, the hair short and easily lost in* A. tenuis. (Anaphora *Clemens*).

3. **A. popeanellus** Clemens. Brownish luteous or dull reddish brown, rarely more urplish; distinctly paler along fold and inner margin. Thorax often pale, especially ı female. Fore wing obscurely and irregularly striate with darker brown; scales ot noticeably raised; blackish patches at end of cell and at middle of fold, and, ormally, a dark antemedial bar across fold. (Fig. 95.) 25–30 mm. (*scardina* eller, *agrotipennella* Grote, *confusellus* Beutenmüller).

New Jersey to Missouri, Florida, and Texas.

A. busckella Haimbach, found at Brown's Mills, New Jersey, appears to be a black berration of this species, with a contrasting, pale inner margin.

4. **A. confusellus** Dyar. Markings similar to *A. popeanellus*. Ground normally nottled with whitish or luteous, but sometimes wholly dark and purplish, as in *1. tenuis*. Slightly smaller than *A. popeanellus*, on the average. Male genitalia ıbout as in *A. popeanellus*, but with the uncus shorter and weaker and the valve narkedly broader.

The moth occurs in July, in the northern part of its range.

Plummer's Island, Maryland, to Georgia and Texas.

5. **A. tenuis** Walsingham. Nearly uniform purplish, with obscure dark markings; ıncus curved over evenly, not angulated, and with more widely separated points han in *A. popeanellus*; valve spoon-shaped, distinctly narrowed at base, and with small supplementary process. 20–25 mm. (*violacellus* Beutenmüller).

This is a more southern species than *A. popeanellus*. It flies in June.

Florida; North Carolina; central Illinois; Iowa; and elsewhere.

6. **A. texanellus** Chambers. Moth smaller and rather slenderer than *A. tenuis*, with more or less distinct traces of an oblique shade crossing the apex, as in

A. hulstellus. Uncus (fig. 96) with points separate, down-curved; valves slend concave, uniform in width.

There seems to be some confusion as to the identification of this species. the Barnes collection, the name is represented by a form with scattered whi scales on the fore wing, and with valves as in *A. hulstellus.*

North Carolina, Texas.

7. **A. hulstellus** Beutenmüller. Similar to *A. texanellus* but larger and coarse with a strong, oblique, dark shade across the wing two-thirds of the way to the ape

Plummer's Island, Maryland, to Florida.

8. **A. mortipennellus** Grote. Pale, dull brown, usually patchily marked wi dark brown; the discal spot most persistent. Female longer-winged and mo evenly yellowish brown. Uncus of male (fig. 98) much as in *A. popeanellus,* b with the points somewhat enlarged and bluntly rounded; valves very slende constant in width, and evenly down-curved. R_3 and R_4 or R_4 and R_5 are ofte stalked. 25–30 mm. (*Hypoclopus* Dyar).

The distribution is uncertain. The material before me is from Missouri.

IV. *Palpus of male as in group III, but with somewhat heavier vestiture palpus of female long, rather drooping, beaklike; thoracic vestiture a in group III; fore wing with all veins free; male antenna with lamina tions hardly twice as high as the length of a segment. Male with lon supplementary process beside the valve. Eyes hairy.* (Acrolophus).

9. **A. plumifrontellus** Clemens. Usually light reddish gray, with irregular, dar striation, gathering into patches at end and near middle of cell, and also, basa of middle and near middle of fold; these patches sometimes connected to form zigzag mark, but sometimes partly or wholly absent, especially in the femal Rarely with but little or no reddish tint. (Fig. 97.) 35 mm.

The moth flies in June and July. The southern race **cervinus** Walsingham is somewhat smaller and more brilliant.

Southern New York to western Pennsylvania and Florida.

V. *Fore wing with* R_3 *and* R_4 *invariably long-stalked; uncus simple. Eyes naked* (Hypoclopus).

A. griseus Walsingham. Typically ashy white, often ranging from light blue gray to fuscous, with confused blackish markings. Hind wing brown. Valve broad oblique, narrow at base, squarely truncate. 22–25 mm.

July. The eastern record for this species is based on a related but quite dis tinct, undescribed species, differing in structure as well as in its darker color.

Texas; Arizona.

Subfamily TINEĪNÆ.
(Tineidæ, in strict sense)

Head more prominent, though often with small eyes; eyes naked; palpus porrect or somewhat upturned in life, not large, clothed with scales and bristles, which are regularly arranged in most cases; tongue usually present; maxillary palpus usually folded, porrect in Amydria, absent when tongue is absent. Antenna typically with the basal whorl of scales on each segment reduced or replaced by a whorl of bristles, often entirely concealed; the outer whorl often raised at a sharp angle, and when flat covering the whole surface of the segment, whereas the two whorls (when there are only two) of the Adelidæ and Acrolophinæ are equally developed and usually of contrasting colors. Outer whorl rarely somewhat interrupted below, but antenna never laminate as in Acrolophinæ. Head with rough bristly vestiture on both vertex and front, though comparatively smooth in the Amydria group. Hind tibia often bristled, but not with a regular row of bristles. Fore wing with R_5 running to costa or apex.

Larvæ with front not reaching vertex; prespiracular setæ of prothora (fig. 92)

losely grouped; setæ i of abdomen farther apart than ii; iv and v widely separated, on separate tubercles. Prolegs with uniordinal hooks, in a complete ellipse r shortly interrupted on inner posterior side; the anal prolegs with a short band. The larvæ are generally case-bearers, the case usually ending in a three-cornered alve, as in the lower Coleophoridæ and Psychidæ; occasionally it is lenticular. The larvæ are often scavengers.

Pupa only lightly soldered together; wing lanceolate; antenna extending to wing ip; in Tinea, at least, with two prominent spines at the end of the abdomen. Cocoon of silk, usually in the larval case.

2. *SCARDIA* Treitschke

Antenna moderate, with pecten and with raised scale-whorls. Maxillary palpus small but folded; tongue strong and naked. Palpus long, porrect, with a large tuft on under side of second joint and bristles on outer side; third joint long, upturned. Head rough. Wings heavy, hardly lanceolate. Fore wing sometimes with R_3 and R_4 stalked, hind wing with M_1 and M_2 connate; with fringe one-half as wide as membrane. Hind tibia with long hair.

The larvæ bore in fungi.

Key to the species

1. Blackish, with contrasting, pale inner and outer margins.
2. Fore wing broader ..... 6. *anatomella.*
2. Fore wing narrower; with distinct, paired, pale costal striæ..... 5. *fiskeella.*
1. Ground paler, often heavily overlaid with blackish; inner and outer margins not pale.
2. A black discal bar (inconspicuous when the region about it is blackish).
3. Fore wing with a dark postmedial fascia, angled on outer, and erect on inner, side. Expanse 25 mm..... 1. *fuscofasciella.*
3. Fore wing with the postmedial fascia rather evenly excurved. Expanse 18 mm. ..... 2. *errandella.*
2. No black discal bar.
3. A contrasting, pale antemedial fascia between the dark basal and medial areas ..... 4. *pravatella.*
3. No such pale, complete band..... 3. *approximatella.*

1. **S. fuscofasciella** Chambers. Clay color, dusted and mottled with brown, with more or less paired, dark costal striæ; the dark postmedial fascia quite obscure and concave below the angulation. 28 mm. (*Euplocamus* Chambers).

This species was described from Kentucky.

2. **S. errandella** Busck. Similar to *S. fuscofasciella*, the ground more evenly luteous, the markings dull fuscous, with the usual purplish iridescence more sharply contrasting. The paired costal striæ distinctly pale; the darker postmedial band as in *S. fuscofasciella*, containing the slightly darker discal bar. 18 mm. (*tessulatella* auct., not Zeller).

July and August in western Pennsylvania.

3. **S. approximatella** Dietz. Luteous, dusted and mottled with fuscous; the dark fascia somewhat anterior to the middle; irregular on basal side, and often running in below the cell to join an oblique fascia from base of costa, thus forming a sort of W which is nearly erect on outer side. A subterminal dark streak running to the costa before the apex. Antennal cilia long (2). 15 mm.

The moth occurs in July. The larva has been found in a rotting sycamore log. Massachusetts to western Pennsylvania and Georgia. New York: Ithaca.

4. **S. pravatella** Busck. Similar to *S. fuscofasciella*, with basal third heavily dusted and contrastingly dark except on inner margin. Wing narrow. 23 mm.

Western Pennsylvania.

5. **S. fiskeella** Busck. This species is distinguished from *fuscofasciella* and *pravitella* by the lack of transverse bands, from *anatomella* by the narrow wings and the tendency for the pale outer margin to widen more opposite the cell. 25 mm. North Carolina.

6. **S. anatomella** Grote. Dull black, reticulate and mottled with intense black; discal bars light. Slight pale spots on costa; outer and inner margins very irregularly edged with a contrastingly pale, clay-colored area, dusted with dark fuscous and sometimes broken into spots. 25 to over 30 mm.

The moth occurs in June and July in western Pennsylvania and is also known from western Ontario. Dietz records it from New York.

3. *ELATOBIA* Herrich-Schæffer

(*Abacobia* Dietz, not Lacordaire; *Dietzia* Busck)

Similar to Tinea; M_1 and M_2 of hind wing stalked; tongue and maxillary palpi smaller than usual but not absent. Antenna half as long as fore wing, with pecten. Hind wing as wide as fore wing. Palpus with second joint clavate, third with some bristles. Female ovipositor membranous.

Larva dirty white, with reddish head and anal plate and blackish cervical shield and tubercles; boring in the bark of pine in early spring.

1. **E. fuliginosella** Zeller. Dark fuscous brown; hairs of head and palpi white-tipped; discal spots darker. Hind wing paler. 14–19 mm. (*martinella* Walker, *carbonella* Dietz).

The moth occurs in July.

Hazleton, Pennsylvania; Hudson Bay district; Colorado; Europe.

4. *TINEA* Linnæus

Small moths, the largest hardly an inch in expanse. Palpus smallish, smooth-scaled, and more or less distinctly bristled on outer side, occasionally with some spatulate scales. Head, including front, with rough, bristling hair, often contrastingly colored. Maxillary palpus and tongue developed; antenna with whorls of raised scales and pecten. Hind tibia with spurs above middle. All veins free. Base of **M** more or less distinct; M_2 and M_3 of hind wing stalked in *T. rileyi*. Hind wing lanceolate, about as wide as fore wing.

Argyresthia may be distinguished by the smoother face, and by R_5 running to outer margin; Acrolepia, by the much smoother head.

In the following key I have only been able to include the species known to me personally, and a few others of striking character. There are a good many other described forms, some of which may not be valid.

Key to the species

1. Hind wing (fig. 73) as broad as fore wing; subcosta extending three-fourths its length or more, and cubital branches long, except in a few species with yellowish head and simply marked fore wings; costa not sinuous.
2. Head dull ochre to fuscous. Fore wing usually nearly concolorous, or if blackish, strongly mottled, and with dark discal dots (obscure in the dark form of *T. carnariella*).
3. Eyes narrower than the distance between them below.
4. Eyes very small, half as wide as the distance between them; fore wing obscurely mottled in two shades of fuscous.....2. *obscurostrigella.*
4. Eyes two-thirds as wide as the space between them; mottling contrasting, blackish on luteous.....1. *misella.*
3. Eyes wider than the space between them below.
4. Ground even, shining; each scale dark-tipped; discal dots distinct. 10. *pellionella.*
4. Fore wing mottled, with blackish scales in groups, or with scattered, contrasting, dark scales, at least toward apex.
5. A blackish longitudinal streak from base to apex.....4. *apicimaculella.*

5. No longitudinal streak from base to apex.
6. Head ochreous; scape of antenna with an ochreous dot.
7. Fore wing dominantly blackish, with contrasting yellow inner margin ..... 6. *bimaculella.*
7. Fore wing dominantly yellowish or fuscous.
8. Hind wing much narrower than fore wing, with a short Cu_2.
9. Expanse about 12 mm.; fore wing with a single (claviform) black spot in fold ..... 7. ———
9. Expanse about 9 mm.; fore wing with a more or less distinct series of dots in the fold ..... 5. *straminiella*
8. Hind wing fully as wide as fore wing, with long Cu_2.
9. Fore wing with a conspicuous series of blackish bars in base of fringe ..... 9. *grumella.*
9. Fore wing without contrasting dark bars in fringe. 8. *carnariella.*
6. Head fuscous; fore wing dominantly fuscous; scape of antenna all fuscous.
7. Ground dark purplish fuscous, either plain or mottled with blackish; tegulæ unicolorous ..... 11. *grisseella.*
7. Ground luteous, mottled with fuscous or brown; tegulæ only half fuscous ..... 3. *fuscipunctella.*

2. Ground blackish, without discal dots, or with pale ones; head frequently yellow and strongly contrasting.
3. Fore wing without pale marginal spots.
4. Thorax with a central, yellow stripe ..... 14. *thoracestrigella.*
4. Thorax solid dark brown ..... 13. *croceoverticella.*
3. Fore wing with a series of contrasting, cream-white marginal spots. 15. *ophrionella.*

Hind wing (fig. 74) almost without exception decidedly narrower than fore wing; the fringe wider than the membrane; Sc reaching margin three-fourths of the way out; costa a little emarginate near the middle; discal spots generally obsolete; head white, as a rule, and. in broad-winged species, never ochre yellow.

2. Fore wing with longitudinal stripes.
3. Fore wings white, markings dark; head white.
4. Two longitudinal stripes through the disc ..... 16. *roburella.*
4. Numerous longitudinal lines ..... 17. *multistriatella.*
3. Head and fore wings dark brown, streaked with white ..... 18. *rileyi.*
3. Head brown and white, fore wing dark-striped on gray ..... 17½. *atriflua.*
2. Fore wing without strongly marked longitudinal stripes.
3. Scape of antenna blackish.
4. Fore wing with considerable areas of brown, often forming brown shades; median fascia often confused.
5. Two oblique, dark, median fasciæ, the outer half of the wing half blackish ..... 24. *marmorella.*
5. A single angulate, or broken, black median fascia.
6. Head white, slightly gray behind antennæ.
7. Basal fascia extending across cell ..... 26. *granella.*
7. Basal spot on costa only ..... 27. *fulvisuffusella.*
6. Head cream color, with large blackish areas behind antennæ; larger ..... 26. *cloacella.*
4. Fore wing lightly dusted with gray (the scale-tips dark); a square, black patch at middle of costa alone contrasting ..... 20. *auropulvella.*
3. Scape white; fore wing white.
4. Ground with a few gray-tipped scales; fascia of powdery gray. 21. *acapnopennella*; 21½. *tylodes.*

4. Ground white, contrastingly marked with black.
5. Median black fascia complete, or broken at middle; costa black o basal fourth ..... 19. *arcell*
5. Median black fascia not reaching inner margin; with but little blac at base of costa.
6. Strongest markings a square black patch on middle of costa and dot at apex of membrane ..... 22. *apicisignatella*
6. The strongest marking a broad median fascia crossing the fold. 23. *angulifasciella*

See also: 12 *misceella*, 25. *fuscomaculella*, 29. *nigratomella*, and 28. *maculabella*

1. **T. misella** Zeller. Eyes small, elliptical, separated by nearly twice their width Palpus rather longer than usual, with considerable hair on the second segment Cu_2 of hind wing three-fourths as long as width of wing.

Clay color; shoulder fuscous; fore wing heavily mottled with fuscous striæ tending to gather into quadrangular spots, among these the inconspicuous disca spots. Costal fringe barred. 12–23 mm.

The Pennsylvania specimens before me are darker, and appear to have les loose hair on the palpi than the European ones.

June to August.

Europe; Minnesota; Pennsylvania; Texas; Florida.

2. **T. obscurostrigella** Chambers. Similar to *T. misella*. Eyes rather smaller. fore wings more evenly and less contrastingly mottled (sometimes nearly even, except for the discal dots). 12–18 mm.

May, July, and October.

Hazelton, Pennsylvania; St. Louis, Missouri.

3. **T. fuscipunctella** Haworth. Pale fuscous, tending to clay color, with a somewhat reddish head. Antennæ blackish. Palpi and antennæ nearly concolorous. A transverse, dark band across front of thorax and basal half of tegulæ, extending along the costa of the fore wings a tenth of the way out. Fore wing more finely and less extensively mottled with fuscous than in *T. obscurostrigella*; costal and dorsal fringes barred. Dorsal spots large, diffuse, contrasting, sometimes joined by a dark shade extending to base of wing. Hind wing paler, hardly iridescent. 11–17 mm. (*nubilipennella* Clemens, *Œcophora frigidella* Packard).

The black bar at the base of the costa seems to be distinctive. The eyes are normal in this and the remaining species of Tinea. This moth appears to be our commonest Tinea, and flies in May and June, and again in August. The larva breeds in the trash in pigeons' nests and similar refuse.

Labrador to Pennsylvania; Europe.

4. **T. apicimaculella** Chambers. Dull straw yellow or clay color. Outer side of palpi blackish. Thorax dark with some clay color on the tegulæ. Fore wing with the costal region shaded heavily with fuscous, the shade extending to the blackish streak on the outer part of the wing, and beyond it to the fold, toward the base. A blackish streak from the base almost to the apex, interrupted around the black outer discal dot. Reniform and claviform dots strong, blackish.

Basal half of fringe barred with blackish. 11–15 mm.

The moth has been taken in June northward, and from April to July in the south.

New Jersey to Florida, Kansas, and Louisiana.

5. **T. straminiella** Chambers. Straw yellow. Sides of palpi and of thorax brown. Fore wing dusted with brown toward apex, with a row of dark spots along the fold and one at the end of cell. 8 mm.

This species was taken in June. No authentic material seems to be known; I believe it is a light variety of *T. bimaculella*.

Kentucky.

6. **T. bimaculella** Chambers. Head pale yellowish, antennæ fuscous; tegulæ dark brown. Fore wing narrow, lanceolate, light yellow, heavily dusted with fuscous, or solidly purplish, most of the inner margin contrasting, clear light yellow. Outer

cal dot large, blackish when not lost in the dark ground. Three blackish spots fold, near base, and before and beyond middle. Hind wing narrow as in the nella group. 9 mm. (*mandarinella* Dietz).

have seen the types of both names, and they are the same species. The species ermined by Kearfott as *bimaculella* is not a Tinea.

June to August.

New Jersey to Ohio and Kentucky.

. T. ————. Straw yellow. Head brighter yellow, with a black patch ind each antenna. Antennæ blackish, palpi blackish, except on inner side vard apex. Disc of thorax and shoulders blackish. Fore wing with costal edge irly black on basal half, the costa more broadly dark at base. Wing sur- e lightly dusted with fuscous, tending to leave the veins free. Three black cal dots, the outer much the larger. Membrane of hind wing not quite so low, three-fourths as wide as the fore wing. Cu_2 short. 12 mm. (*trimaculella* ambers?)

July.

St. Louis, Missouri; (District of Columbia; Kentucky). New York: Otto.

8. **T. carnariella** Clemens. Similar to the preceding species. Deeper ochre llow, the fore wing sometimes suffused with fuscous, leaving a contrasting llow inner margin. Head without a black spot behind antennæ; palpi yellower inner face; disc of thorax mostly yellowish. Fore wing more or less dusted th blackish scales, costal edge less contrastingly blackish, discal spots larger, fuse, the one in the fold obscure. Hind wing dirty white, broad. 15 mm.

June.

St. Louis, Missouri; Pennsylvania.

9. **T. grumella** Zeller. Head ochreous, darker than in *T. pellionella*. Yellowish, aded with fuscous, especially toward costa and beyond the discal dot, but leaving e fold contrastingly pale. Usual spots dark, the one in the fold short. A series blackish terminal bars. Hind wing somewhat narrower than fore wing. –18 mm. (?)

The length of the fore wing is given as four lines, which is too large for any- ing I have seen determined as *grumella*. The present description is condensed om Zeller's.

July.

Massachusetts.

10. **T. pellionella** Linnæus. (The old-fashioned clothes-moth.) Pale fuscous ay, a little shining. Head yellower than ground, but not decidedly yellow as in e preceding species. Antennæ, including whole of scape, and palpi, blackish. ore wing with a good many scales darker toward apex, but with no definite sting; discal spots distinct, but blurred; no terminal bars. Hind wings light ay. 10–15 mm. (H. p. 473, f. 253.)

The larva is white with a brown head and collar, and lives in a parchment-like se of white silk. It is one of our clothes moths, feeding on woollen goods, furs, d other dry substances of animal origin, but appears to be much less common nder American conditions than is *Tineola bisselliella*.

The distribution is said to be general; I have seen the species from Michigan ad Missouri, and, I think, from Alabama.

New York: Reported from Louisville, Canandaigua, and Alfred Center.

11. **T. grisseella** Chambers. Fuscous, head somewhat yellower than fore wing, ith ochreous and fuscous palpi. Fore wing heavily striolate on a clay-colored ound. Outer discal dot distinct, and also two dark bars in the fold. 8 mm.

I have seen no authentic material of this species. The original description is rongly suggestive of **T. pellionella.**

Kentucky.

12. **T. misceella** Chambers. Head and palpi pale yellowish; antennæ pale fus- us; fore wings dusted with fuscous and saffron yellow in about equal propor- ons; two discal spots, one two-fifths of the way out, in the fold, and a smaller ne at end of cell. 8 mm.

This species is unknown to me; it should be recognizable by the light palpi, a the absence of the first discal dot, or its fusion with the claviform.

Kentucky.

13. **T. croceoverticella** Chambers. Head bright ochre; antennæ blackish, wi some ochreous scales on scape; palpi dull ochreous, grayish on outer side, wi rougher, longer vestiture than usual, twice as long as the width of the joi but not spatulate as in Elatobia. Thorax dark mouse gray, the apical half the tegulæ clay color, contrasting. Fore wing blackish, with slightly dark shades in place of the discal dots, with obscure, pale marginal bars toward t apex, and a pale streak at the base. Two dark lines in fringe. Hind wing da 10–15 mm.

The larva is a case-bearer and feeds externally on the flat, white bracket fun on beech, usually on small bits. The case tapers to a neck at each end and th has a flaring mouth. It is covered externally with sawdust and grass. It h been found in June and the moths emerge about the first of July.

Maryland to Kentucky, Kansas, and Saskatchewan (Regina) Canada.

14. **T. thoracestrigella** Chambers. Similar to *T. croceoverticella*, small brighter, not bronzed, without lines in the fringe. 10 mm.

This species is definitely known only from Texas, but is doubtfully credit to Kentucky in Dyar's list.

15. **T. ophrionella** Dietz. Deep purple-brown. Head yellowish white with so black hairs behind. Scape silvery, inner side of palpi white. Fore wing with series of six or seven white marginal bars, with a wider space between the tw middle ones, and several on the inner margin lying mostly in the fringe; a sing white discal dot and several white patches below the fold. 11–14 mm.

June.

Parry Sound, Ontario. New York: Uphill Brook (Mt. Marcy).

16. **T. roburella** Dietz. Head white, a fuscous spot on vertex; thorax a fore wing white, dusted and shaded with pale brown. A large, seal-brown sp from middle of costa to middle of wing, crossed by two longitudinal, dark streak Inner margin also narrowly dark on outer part of wing. Margin and frin barred with brown, the latter with a dark central line. 13 mm.

Essex County, New Jersey.

17. **T. multistriatella** Dietz. White, lightly dusted and finely streaked wi fuscous; with five or six partly confluent streaks, sometimes broken up in dashes and dots, the costal spots smaller. 17 mm.

Bred from fungi on beech stumps.

Toronto, Ontario; Maryland.

17½. **T. atriflua** Meyrick. Head white, shaded with fuscous on the sides thorax dark, with apex of tegulæ whitish. Fore wing dark-dusted on a grayis white ground, the margins narrowly white, also with dark scales. Two blac dusted streaks, one from base of costa to apex, widening outwardly and occup ing nearly half the width of the wing at the outer margin; the other below t fold; both edged with white. Some small bars on outer margin, and powde dark dots in the white fringe. Hind wing pale gray with paler fringe. 13 mm (Unknown to me).

June.

Toronto, Ontario.

18. **T. rileyi** Dietz. Seal-brown, head nearly black, including outer side of pal and scape; tegulæ white-dusted. Fore wing with about five fine, white lin and white costal and dorsal edges. Fringe checkered, largely white.

The larvæ feed on fungi. The moths emerge in June.

Pennsylvania; District of Columbia; Florida.

In the remaining species of Tinea, the hind wing is about three fourths as wide as the fore wing, with the costa noticeably sinuate an **Cu**$_2$ no longer than **Cu**$_1$; the head and palpus are white, the palpu

being black on the outer side of the second segment and extreme base of the third, except as noted.

19. **T. arcella** Fabricius. Head all white, tegulæ with a black spot at base, palpus occasionally all black on outer side, normally typical; scape white. Thorax and fore wing white, fore wing with a little yellow shading and an angulate, black, median band, sometimes broken; a spot covering the basal fifth of the costa, and smaller blackish marks outwardly. 12 mm.

American specimens are not typical and may represent a new species. The larva as known in Europe is yellowish white, with a bright brown head, and has been bred on fungi under the bark of dead alder twigs.

July.

Europe; Connecticut to District of Columbia and Indiana; California (?). New York: Ithaca (Dietz).

20. **T. auropulvella** Chambers. Head white; *scape partly dark gray;* second segment of palpus outwardly all black, third segment all white. Fore wing white, mottled with a little light golden brown, with a square, black spot on the middle of the costa, continued by a narrow streak across the cell in dark specimens; a black antemedial spot and sometimes a basal spot on the costa; some other small black spots present, mostly on the margins. 11–16 mm.

June and July.

New Hampshire to North Carolina and Kentucky, westward to British Columbia. New York: Ithaca.

21. **T. acapnopennella** Clemens. Head with some gray scales, thorax and fore wing in some specimens considerably dusted with black-tipped scales, *scape white,* palpi typical. Pattern of fore wing about as in *T. auropulvella,* but less contrasting; the spots at the base of the costa rarely conspicuous. 10–16 mm. (*minutipulvella* Chambers).

June to August. Larva on *Polyporus tulipiferus;* whitish, with dark head and cervical shield.

Canada to Louisiana. New York: Ithaca, Albany.

21½. **T. tylodes** White. Antenna light gray, palpus with a dark streak on outer side of second joint; shoulder with a gray spot. Fore wing with some irregular yellowish scaling, and gray dusting, especially toward outer margin; markings blackish gray; some striæ on margins; a streak along basal fifth of costa; a semioval spot on middle of costa with a rhomboidal spot before it on inner margin; an irregular outer spot on costa. Apical fringe with two more or less distinct gray shades. Hind wing light gray with paler fringe. 14 mm.

Meyrick does not compare this species, which is unknown to me, with any other. It may be the same as *acapnopennella.*

July and August.

Toronto and Muskoka Lake, Ontario.

22. **T. apicisignatella** Dietz. Head and scape white, shaft of antenna light brown; palpi typical. Fore wing dull whitish, spotted with black; a black square at middle of costa, extending well into the cell, and an equally large, black, subterminal spot separated by a narrow white band from the black apex; fringe barred. 12–13 mm.

This species is very close to *T. auropulvella* but appears distinct.

New Hampshire; Pennsylvania.

23. **T. angulifasciella** Dietz. Head white with a gray posterior tuft, half of third segment of palpus black; scape white; shaft of antenna pale; shoulders black; fore wing white; markings all black; heavy basal line reaching the fold, the base of the costal edge black; a small antemedial dot, a heavy angulate median fascia, extending to below the fold and sometimes weakly even to the inner margins; outer part of wing strongly mottled with black, forming a large, central dark patch. R_4 and R_5 stalked.

Plummer's Island, Maryland.

24. **T. marmorella** Chambers. Head and palpi yellowish white; second segment and half of third segment of palpi brown on outer side; antenna dark; scape blackish. Fore wing white, spotted with black; basal fifth of costa black; a little black toward inner margin; an antemedial, outwardly oblique, black fascia crossing the cell and fold (apparently interrupted in the specimen before me); a similar postmedial fascia covering the end of the cell; some other black markings on disc, and margins barred with black. 10 mm. (not "three-sixteenths inch"!)

Toronto, Ontario, May 25.

25. **T. fuscomaculella** Chambers. Closely similar to *T. marmorella;* the basal black streak on the costa running into an oblique fascia as in *T. marmorella* and *granella,* but the markings on the outer part of the wing less confluent. 12 mm.

I am not sure that this form is distinct from *T. marmorella;* the Canadian specimen of *marmorella* before me seems intermediate.

Kentucky.

26. **T. granella** Linnæus. Head rarely yellowish, with some gray behind the antenna. Scape black; palpi with only the tip of the third segment white outwardly. Fore wing white, more or less mottled with dark, bronzy brown, and spotted with black. Disc of thorax fuscous, tegulæ black with white tips. Fore wing with a black basal bar, antemedial spot, median bar extending into the cell, with a separate dot in the fold, and smaller outer bars, the two outermost sometimes as in *T. apicisignatella.* The markings often leaving clear a vague, white discal dot. Fringe with dark center-line, crossed by two white bars. 12 mm. (*variatella* Clemens).

The caterpillar is yellowish white, with a red-brown head and two curved, brown stripes on the neck. It feeds in grain, dried fruits, bracket fungi, and similar substances, breeding continuously when the temperature permits.

Europe. Distribution apparently general in the eastern United States. New York: Albany, Batavia.

T. cloacella Haworth is very similar, but with a yellow head, more dark behind the antennæ, and sparser and paler brown mottling, contrasting with the black spots. It is something of a pest in Europe but has not been authentically reported from America.

27. **T. fulvisuffusella** Dietz. Very near *T. granella,* but smaller, with lighter brown mottling, and less extensive black markings. 11½ mm.

Hampton, New Hampshire.

28. **T. maculabella** Chambers. White. Antennæ sordid yellowish white. Thorax with three brown spots in a triangle. Fore wing white, lightly dusted with dark brown, and marked with dark brown; a brown spot at base of costa, an antemedial spot and an oblique irregular streak from before the middle of the costa to beyond the fold, interrupted on the fold; a small spot on middle of costa; and a postmedial streak running into a large, longitudinal patch in the middle of outer part of wing; a couple of subapical, longitudinal streaks. All the markings more or less mottled and defined with reddish yellow. A series of dark terminal spots. R_4 and R_5 stalked. 14–22 mm.

This species is unknown to me, but its large size appears distinctive, as well as the longitudinal apical dashes.

Pennsylvania; Kentucky.

29. **T. nigratomella** Dietz. Palpi, head, and antennæ sordid yellowish white; palpi dusted with brown, antennæ faintly annulate. Fore wing white, heavily and almost evenly dusted with brown, gathering in two vague transverse bands, the first erect and the other oblique. Costa at apex barred with alternate dark brown and white spots. 8½ mm.

This species is unknown to me and may be a Diachorisia, like "*Tinea*" *marginimaoulella* and "*T.*" *fuscopulvella,* with which it is compared.

Montclair, New Jersey.

I have seen a specimen from Pennsylvania labelled *Tinea defectella* Zeller. Its fore wing is white, patchily mottled with fuscous, tending to form oblique fasciæ, and the head is fuscous and white. 8 mm. I am not sure it is rightly determined.

T. uterella Walsingham, a blackish tropical species a good deal like *T. misella*, but lacking the pecten, is likely to occur in the warmer States. The larva is Tinea-like but with heavy thoracic sclerites, and forms a flat case like a melon seed. The species is usually put in the genus Tineola, but the tongue and maxillary palpi are preserved.

5. *TRICHOPHAGA* Ragonot
(*Tinea*, in part)

Tongue obsolete; but maxillary palpi preserved; costal veins as noted in key (fig. 78). Otherwise like the first group of Tinea. Antennæ rather more smoothly scaled than in Tinea, with only a narrow naked area at the base of each joint.

1. **T. tapetzella** Linnæus (Case-bearing clothes moth). Blackish, outer half of fore wing contrastingly whitish. 12–24 mm. (**H** p. 434 f. 254.)

This species is apparently nearly world wide. The larva is a clothes moth and general scavenger, often breeding in owl-pellets; it is pale, with a black head and a dark brown shield.

Distribution general south of New York City. New York: New Dorp, Staten Island.

6. *MONOPIS* Hübner
Blabophanes Herrich-Schæffer

Body and head like Tinea. Antennæ usually with rather strong sense bristles. Fore wing (fig. 77) with a small fovea near middle; M_3 and Cu_1 stalked, R_4 and R_5 sometimes stalked, Cu_2 often stalked with M_3 and Cu_1. Hind wing with M_1 and M_2 rarely stalked.

Spuler makes a separate family, Monopidæ, for this genus; but the characters are not unlike those of Tinea, and the larval habits are the same.

Key to the species

1. Disc of thorax and inner margin of fore wing contrasting yellow.
2. Thorax and inner margin bright yellow.
3. Fore wing blackish with violet iridescence.....3. *ferruginella.*
3. Fore wing blackish fuscous, flecked with pale ochreous.
4. *crocicapitella.*
2. Thorax and inner margin yellowish white.....2. *dorsistrigella.*
1. Disc of thorax concolorous, and inner margin slightly paler, or with concolorous inner margin
2. A pale spot on middle or outer part of costa.
3. Inner margin solidly dark or with a small dot at anal angle
5. *monachella.*
3. Inner margin paler or with a pale patch, at least half as large as the costal one.
4. Costa without dark spots before the middle.....6. *biflavimaculella.*
4. Costa with alternate clay-colored and dark striæ
5. Tips of tegulæ pale.....1. *irrorella.*
5. Tips of tegulæ concolorous.....7. *marginistrigella.*
2. No pale areas on any part of wing.....8. *rusticella.*

I. *Cell half as long as fore wings:* R_4 *and* R_5 *separate, as a rule;* Cu_2 *free,* M_1 *and* M_2 *of hind wing separate. Male valves with straight ends and sharp angles. Cell more than half the length of fore wing* (Blabophanes).

1. **M. irrorella** Dietz. Equally mixed with whitish and dark brown; head saf-

fron yellow; anal angle dark brown, inner margin dominantly pale, except at anal angle; costa also paler, especially toward middle. Thorax blackish; tips of tegulæ luteous. 11–14.5 mm.

June.

Pennsylvania; New York: Otto.

2. **M. dorsistrigella** Clemens. (Cu_2 rarely stalked). Head, disc of thorax, and inner margin of fore wing white, sometimes tinted with yellow; streak on inner margin widened before and beyond the middle; a triangular white patch in middle of costa, reaching down to the fovea; a few white flecks at the apex. Tegulæ and ground color of fore wing dark purplish brown. 12–14 mm. (*subjunctella* Walker).

June and July.

Massachusetts and North Carolina to southern Ontario, Missouri, and New Mexico; probably general. New York: Ithaca, Sea Cliff, Long Island.

3. **M. ferruginella** Hübner. Black with violet iridescence, Dorsal streak light cream-color, slightly widened before and beyond the middle; costal patch white, usually reduced to a few scattered scales. Head bright ochre. A few silvery flecks at apex. Hind wing purplish fuscous in male, darker in female. 11–15 mm.

The larva is a clothes moth and a general scavenger.

This species is definitely known only in Europe, but is to be looked for, mixed with *M. crocicapitella*.

4. **M. crocicapitella** Clemens. Similar to *M. ferruginella*; the ground color somewhat purple-brown, paler and flecked with yellow along the costa and outer third of the wing; the triangle not distinct; hind wing and fringes pale gray. 9–17.5 mm. (*hyalinella* Staudinger, *lombardica* Hering, *heringi* Richardson, *ferruginella* Dyar, not Hübner).

July to October.

The larva has been bred from seeds of absinth and refuse, and the moth has been taken in a cave, associated with bats.

New York to California, probably general; also in Europe and Hawaii. New York: Morrisania (New York City); Clove Valley, Staten Island.

II. *Fore wing with* R_4 *stalked with* R_5, Cu_2 *with* Cu_1 *and* M_3; *fovea small. Cell about half as long as wing. Hind wing with* M_1 *and* M_2 *separate.*

5. **M. monachella** Hübner. Mottled fuscous gray. Head and thorax white; a large, trapezoidal, costal white patch, reaching the fovea. R_4 and R_5 stalked, Cu_2 short-stalked. 11–17 mm.

Europe.

This species seems to have been introduced in Manitoba, and at St. Hilaire, Quebec. It flies in June and July.

6. **M. biflavimaculella** Clemens. Head pale luteous. Thorax dark brown with a pale spot in front. Fore wings mottled umber brown tinged with violet; a strongly contrasting, triangular, cream-white patch on middle of costa, and a smaller one farther out on inner margin. 15 mm. (*insignisella* Walker).

The moth occurs in June to September. I have seen a specimen with M_1 and M_2 of the hind wing stalked, and one with R_4 and R_5 of the fore wing completely united.

Labrador to Texas and Washington. New York: Peru, Wilmington, Ithaca, Big Indian Valley.

7. **M. marginistrigella** Chambers. Dark purplish brown mixed with white; head contrasting yellowish white. Pale spots as in the last species, the one on hind margin more narrowly continued toward base. Apex largely pale. 9 mm.

June and September.

Kentucky; southern Ohio; western Pennsylvania.

III. *Fore wing with end of cell and fovea well before middle of wing;* **R**$_4$ *and* **R**$_5$ *and* **Cu**$_2$ *long-stalked,* **M**$_1$ *and* **M**$_2$ *of hind wing long-stalked; valves of male rounded apical* (Monopis).

8. **M. rusticella** Hübner. Almost evenly mottled with purplish fuscous; fovea pale. Head whitish yellow. 14–20 mm.

The moth has apparently been introduced in the New World, and occurs only sporadically in our territory. It flies from May to midsummer, and again in autumn, having two broods.

Eurasia, Truro, Nova Scotia; Toronto; Hampton, New Hampshire. New York: Ithaca (probably introduced).

7. *TINEOLA* Herrich-Schæffer

(*Tinea,* in part)

Moth similar to Tinea but with rudimentary tongue and maxillary palpi. Pecten present. Eyes of male very large.

There is a rudiment of the stigma of Trichophaga, the genus to which this seems most nearly related. It comes from the old-world tropics.

1. **T. bisselliella** Hummel (the clothes moth). Pale straw yellow, head more rusty. Fore wing occasionally with dark outer discal dot. 12–15 mm. (*lanariella* Clemens). (**H.** p. 432 f. 252.)

The larva of this species is the commonest of the clothes moths, and is white with a brown head. It forms slight silken galleries, but lives nearly free. It pupates in a translucent cocoon. It will eat wool, fur, insect specimens and occasionally other dried animal substances, but avoids cotton.

Common and general in distribution. New York: common everywhere.

8. *TENAGA* Clemens

Eyes very small with a naked space all around. Antennæ nearly as long as fore wing; palpi nearly concealed in the rough facial hair. No maxillary palpi or tongue. Fore wing ovate-lanceolate; cell narrow, below middle of wing; one radial lost; **R**$_4$ and **R**$_5$ stalked, **M**$_1$ and **M**$_2$ stalked, but free from **R**$_4$ and **R**$_5$; accessory and discal cells weakly closed outwardly. Hind wing lanceolate without well-marked cell. **Sc** ending about two-thirds way out, but costa not sinuate; **M**$_1$ and **M**$_2$ stalked; **M**$_3$ free; **Cu**$_1$ angulate where the discocellular vein usually is attached; fringe wider than the membrane; anals reduced.

This genus apparently is related to Tineola.

1. **T. pomiliella** Clemens. Yellowish ochreous, with three, irregular, broken, brown fasciæ and scattered spots. 10 mm.

June, August, and September.

Southern Ohio; Pennsylvania.

9. *ISOCORYPHA* Dietz

(*Incurvaria* Clemens, in part)

Similar to Diachorisia. Antennæ smooth-scaled, with a single whorl to a segment. Fore wing (fig. 84) smooth-scaled and slightly shining; **R**$_4$ and **R**$_5$ short-stalked, and **A** simple. Hind wing three-fifths as wide, with **Cu**$_2$ two-thirds as long as its width; and costa not sinuate. All veins separate; anals traceable.

I. mediostriatella Clemens. Antenna nearly as long as fore wing. Head yellow. Shining brown; a large golden yellow patch two-thirds way out on costa; a broad streak through middle of wing, almost or quite connecting with it, and half as wide as the wing; and a patch at beginning of dorsal fringe, usually joining the streak. Hind wing dark. Costa slightly sinuous beyond middle. 8 mm.

July to September.

Superficially, this form is extremely close to *Hybroma chrysocomella,* but it has brown thorax and paler antennæ, besides the venational difference.

10. *DIACHORISIA* Clemens

(*Homosetia* Clemens; *Pitys* Chambers; *Calostinea* and *Stenoptinea* Dietz; *Pelates* Dietz?)

Similar to the last group of Tinea but with some raised scaling on the fore wings; wings often heavily tufted; or more reduced, the fore wing (fig. 82) being lanceolate and the hind wing sometimes linear, with cell nearly marginal. A of fore wing, in the latter case, not forked at base, and wing-scaling sometimes nearly smooth. Occasionally with metallic markings. Antennæ usually smoother than in Tinea, the outer whorl of scales covering nearly the whole of each segment.

The species have not been fully studied and may not all be congeneric. Besides the names listed in the synonymy above, Infurcitinea seems also to be a synonym of this genus, being related to group *Calostinea*. Some of the species listed below may even belong to the Adelidæ.

Key to the species

1. With accessory cell; no definite scale-tufts; hind wing broader, with Cu_2 nearly as long as width of cell, and with anals developed.
   2. Male antennæ distinctly pubescent; fore wing not metallic, R_4 and R_5 stalked; costa of hind wing sinuate (Diachorisia, fig. 82)....1. *velatella.*
   2. Male antennæ smooth-scaled; fore wing with metallic markings; costa of hind wing hardly sinuate, R_4 and R_5 free (Calostinea).
      3. A transverse white fascia.....2. *argentistrigella.*
      3. No transverse fascia .....3. *argentinotella* (?).
1. No accessory cell; Cu of hind wing extremely short, the cell almost touching the margin.
   2. Both wings with all veins free; antennæ long, normal; costa of hind wing sinuate; fore wing with scale-tufts (Homosetia, fig. 80).
      3. Fore wing dark brown or blackish brown.
         4. Face white, vertex black.
            5. A large, well-defined silver spot near the base.
               6. No white terminal dots.....4. *cristatella.*
               6. Distinct white terminal dots on costa and outer margin. 3. *argentinotella.*
            5. No such spot .....5. *obscurella.*
         4. Head orange .....6. *chrysoadspersella.*
      3. Fore wing suffused with tawny or golden brown.
         4. White costal spots.
            5. Spots toward the apex of the fore wing, perpendicular to the costa, equal to the spaces between them.....7. *costisignella.*
            5. Spots narrow, distinct, and oblique.....8. *fasciella.*
         4. No white costal spots.....9. *maculatella.*
      3. Fore wing dominantly grayish fuscous on a white ground, with yellowish spots, if there is any yellow.
         4. Fore wing with golden dots.
            5. Fore wing wider; subcostal tuft of median facia large. 11. *miscecristatella.*
            5. Fore wing narrower, the tuft small.....10. *tricingulatella.*
         4. No yellow or golden.....14. *marginimaculella*
   2. Hind wing with M_1 and M_2 stalked, front with a conical tuft (Stenoptinea).
      3. Apex of fore wing and fringe buff-brown.....13. *auriferella.*
      3. Apex of fore wing and fringe not pale.....12. *ornatella.*

1. **D. velatella** Clemens. (Fig. 82.) Head mixed brown and gray; palpi dark outwardly. Fore wing white, dusted with fuscous; with four or five unequal spots along costa and the usual three discals, which are rather large; the apex with additional confused spots. 9 mm. Antennæ with outer whorls of scales on each segment nearly complete, but no longer than the inner whorls. Ventral surface with strong pubescence, as long as a segment in male; shorter but of the same character in female. Hind wing with cubitus and Cu_2 running straight across to inner margin, with a quarter of the width of the wing below it. Cu_2 half as long as width of wing. (In the rest of the genus **Cu** is closely parallel to the inner margin, and the free part of Cu_2 is very short.)

July.

Maryland; Pennsylvania.

2. **D. argentistrigella** Chambers. Rich, iridescent, maroon brown; face and antennæ below, silvery white; antennæ annulate above. An irregular, silvery fascia before middle, the wing beyond it dusted with white; six costal streaks toward apex, the next to last being the longest, and two dorsal streaks. 12 mm. (*Semele* Chambers.)

I have not seen this form.

Kentucky.

3. **D. argentinotella** Chambers. Similar to *D. argentistrigella;* the fascia on the fore wing absent, or replaced by a costal patch, which typically reaches the cell. 10–17 mm. (*Semele* Chambers.)

The cubitals in the hind wing are very short. In Florida and Texas the moth flies in June.

Western Pennsylvania to Florida and Texas.

4. **D. cristatella** Chambers. Face white, sometimes suffused with fuscous; vertex black; thorax black, with more or less broken silvery or golden basal, antemedial, postmedial, and subterminal bands, defined with raised scales; a heavy tuft beyond the postmedial band on the costa, and a lesser one near the inner margin. Costal fringe dark, dorsal white. 13 mm.

June.

In Illinois they have bred what I believe to be this species from fungus.

Kentucky.

5. **D. obscurella** Dietz. Similar to *D. cristatella,* the silvery markings weaker, and absent at base of costa. 11 mm.

Probably this is a variety of the last species. I have only seen one type, which was in poor condition.

July.

Nicholson, Pennsylvania; Kansas.

6. **D. chrysoadspersella** Dietz. Deep brown; head orange; vertex darker. Fore wing dusted with silvery gray and sprinkled with golden scales; with irregular silvery fasciæ about like *D. cristatella,* but the fringe heavily barred with white at base. Tufts forming heavy transverse bars at a third and two-thirds way out. 8.5 mm.

Plummer's Island, Maryland.

7. **D. costisignella** Clemens. Head white; antennæ dull tawny; palpi tawny yellow. Fore wing tawny; costa marked with about eight pale bars alternating with dark brown and white, the markings extending into the base of the fringe; one small scale tuft at end of cell. 12 mm.

The moth occurs in damp woods in July.

New York; New Jersey; Pennsylvania. New York: Ithaca (Dietz).

8. **D. fasciella** Chambers. Golden bronze; tufts placed on two contrasting dark fasciæ, but themselves small, well separated, and easily overlooked; without the brown, black, and white mottling of the last species 12 mm. (*Pitys* Chambers).

New Hampshire; Pennsylvania; New Jersey; Kentucky.

9. **D. maculatella** Dietz. Head bright ochre yellow; antennæ three-quarters as long as fore wing, fuscous above, and silvery below; thorax powdery; tegulæ dark brown anteriorly. Fore wing dull, powdery gray, tinted with yellow, with irregular dark costal spots and broken fasciæ; tufts small, R_4 and R_5 stalked. 10–12 mm.

I have never seen this form.

Pennsylvania; California.

10. **D. tricingulatella** Clemens. Head blackish; face whitish. Antennæ grayish; palpi gray on outer side. Fore wings over six times as long as wide, gray, slightly dusted with fuscous; a dark spot at base of costa; a band a third way out, hardly reaching inner margin; a broad, irregular, brassy-brown band in middle of wing, besides some brassy areas nearer base, and other irregular dark bands outwardly. Fringe checkered black and white, pale outwardly. 10 mm.

This species and the next are easily recognized by their pattern, which is formed of grayish white, blackish, and golden in about equal proportions.

Northern New Jersey and Pennsylvania.

11. **D. miscecristatella** Chambers. Differs from *D. tricingulatella* only as noted in the key. Fore wing only five times as long as wide; yellow spots normally less developed (*fuscocristatella* Chambers).

Var. **auricristatella** Chambers is pale, with the head wholly whitish.

I have taken the moth in July.

Kentucky; Worcester, Massachusetts.

12. **D. ornatella** Dietz. Face yellowish white; vertex and thorax dark brown; antennæ silver gray. Fore wing dark brown with irregular, silvery and golden patches and oblique bars; with raised, brown tufts. Hind wing more gray. 6.5 mm.

This is said to be the smallest Tineid with folded maxillary palpi. It occurs in July.

District of Columbia.

13. **D. auriferella** Dietz. Similar, the golden and silvery markings on the fore wing less distinct. 8 mm.

District of Columbia.

14. **D. marginimaculella** Chambers. Fuscous ash-gray; head lighter, dull clay color; antennæ gray. Fore wing neatly and regularly spotted with black; rough looking, without any yellow or golden scales. Costa heavily black-marked at base, with four large, black bars toward the middle and three small ones toward apex. Fold with dark spots at middle and four-fifths way out, a dorsal spot toward apex, and spots a quarter, half, and three-fourths way out on the cell, the latter, and the outer one in the fold, larger. Hind wing gray. 10 mm. (*maculimarginella* Chambers; *Tinea* Chambers).

I have seen the type and believe it belongs in Diachorisia. It is certainly no Tinea. It came from Kentucky.

15. **D. (?) heteropalpella** Dietz. Silvery white, reticulate with golden brown; with more or less alternating, dark costal and dorsal spots. Head whitish, mixed with brown on vertex; thorax white; front of tegulæ brown. Maxillary palpi long, folded, the first joint as long as the remainder. Eyes small, round; antennæ three-fourths as long as fore wings, with whorls of loose scales like Tinea; fore wing apparently with R_5 and M_1 stalked; hind wing narrow, costa sinuate. 8 mm.

This species may belong to the Adelidæ (subgenus **Bathroxena** Meyrick; *Pelates* Dietz, preoccupied).

Plummer's Island, Maryland.

16. **D. (?) afflictella** Walker is a plain blackish species, 25 mm. in expanse, which very likely does not belong here (*Tinea* Walker).

11. *CHOROPLECA* Walsingham and Durrant

(*Cyane* Chambers, not Felder)

Similar to Tinea (fig. 89, antenna). Fore wing ample (fig. 86), with **Cu** arising out on the cell not unlike Incurvaria; all veins separate. Hind wing trapezoidal, broad; one vein wanting, all veins separate.

1. **C. vesaliella** Chambers. Whitish, dusted, striate and mottled with blackish. Head dirty white, mixed with brown behind. Antennæ annulate, with groups of darker segments near base, half, three-fourths, and seven-eighths way out. Fore wing with costal area and base dark brown; black in patches, the dark area extending halfway across the wing at its middle as a large spot, and cut by several white bars. Inner margin with a couple of brown spots, and smaller ones on the disc. Apical fringe with white bars, dorsal fringe pale. 8.5–11 mm.

This species looks rather like a Tinea. It flies in June.

Parry Sound, Ontario; south to Florida and Louisiana. "New York" (Dietz).

12. *HYBROMA* Clemens

(With *Isocorypha* Dietz, in part)

Antennæ rather more than half as long as fore wing; fore wing normal, typically with all veins free (fig. 85) in *H.* (?) *chrysocomella* (fig. 83) with R_4 and R_5 stalked and Cu_2 lost. (*H. servulella* shows a trace of the basal fork of **A**.) Hind wing with costa arched, **Sc** extending well beyond middle, **R** straight, running to costa, **M** primitive, forking well before middle of wing, M_{1+2} connected by a transverse vein to **R** but M_3 free; M_1 running to apex. **Cu** forked, free.

In placing *chrysocomella* in this genus rather than in Isocorypha, I have put more weight on the unique venation of the hind wing than on the fore wing, which agrees with that of *mediostriatella*.

1. **H. servulella** Clemens. Bright light yellow; antennæ fuscous. Fore wing with costal edge brown from base, widening into a patch beyond middle, which may rarely extend across the wing; a second patch two-thirds way out; basal half of inner margin with an irregular brown patch. Yellow ground when least extended, appearing as four, partly confluent, rounded spots, besides the yellow apex. 11 mm.

June and July.

Cohasset, Massachusetts, to western Pennsylvania, northern New Jersey, and Missouri. New York: Ithaca.

2. **H. (?) chrysocomella** Dietz. Closely similar to *H. servulella*, but with brown markings more extensive, usually cutting off a rounded yellow spot at the anal angle. Ground rather darker, the markings more purplish. 7 mm.

Kansas and westward.

13. *LEUCOMELE* Dietz

Similar to typical Hybroma; wings (fig. 81) much narrower, hind wing with sinuate costa, **Sc** extending less than half the length of the wing, with all three branches of **M** connected to **R** by a short cross-vein, and base of **M** lost. Ovipositor extensile, membranous.

1. **L. miriamella** Dietz. White; vertex and thorax dark purplish brown; fore wing dusted with blackish, gathering to form streaks along costa and base of inner margin; a couple of bars in fold, and several lesser spots. Apex darker. Fringe checkered at base, outer part whitish with a dark dividing line. 9.5–14 mm.

The types were taken on the trunk of a cherry tree in June. The apical third of the fore wing may be suffused with black except for the barred fringes; and the bars in the cell may fuse into a heavy oblique fascia.

14. *HOMOSTINEA* Dietz

Antennæ two-thirds as long as fore wings; fore wings (fig. 76) lanceolate, R_5, M_1, and M_2 stalked; M_1 sometimes lost, accessory cell present. Hind wings narrower than fore wings, narrow-lanceolate, cell open below media; costa sinuate; Sc only two-fifths as long as fore wing; one medial lost, and radius and M_2 often barely traceable.

1. **H. curvilineella** Dietz. Pale yellow dusted with blackish; antennæ blackish; fuscous dusting variable, and sometimes very slight, gathering at base of costa and forming obscure spots and streaks. First discal dot normally represented by a black spot, and the outer one by a curved, oblique streak. 9–12 mm.

The moth flies in the Gulf Strip in June, and northward in July.

District of Columbia to Missouri, Kansas, and Texas. New York (?)

15. *ŒNOE* Chambers

Head normal; antennæ three-fourths as long as fore wing. Fore wing lanceolate (fig. 75); R_5, M_1, and M_2 stalked; Cu_2 lost; hind wing linear, with short Sc and sinuate costa; M represented by a free, forked or trifid vein; Cu obscurely forked at margin or simple.

1. **Œ. hybromella** Chambers. Head yellowish white, dusted with brown; thorax and basal third of fore wing maroon brown, ending at an erect silvery fascia. Outer part pale green, easily fading to pale yellow, somewhat irregularly dusted with brown. 8–9 mm.

Northward, the moth flies in July, and in the Gulf Strip in June.

Maryland; Pennsylvania; southern Ohio; Mississippi.

16. *MEA* Busck

(*Progona* Dietz, not Berg)

Palpi with second joint bushy, clothed with spreading, hair-like scales on its apical half; leaving the upper edge free, third joint rough and blunt. Antennæ rough-scaled, two-thirds as long, or as long, as fore wings. Fore wing lanceolate, Cu_1 lost, M_2 and M_3 stalked, R_5 and M_1 stalked; R_2 arising well back from angle of cell; hind wing with Sc ending two-fifths way out on costa; costa sinuate; cell closed, M_2 and M_3 stalked. Fringe nearly twice as wide as membrane.

The venation is Tineid, but the sexually dimorphic antennæ suggest the Adelidæ. I have had no opportunity to examine the structure fully.

1. **M. skinnerella** Dietz. Vertex white; palpi and face black. Antennæ fuscous brown, white toward the base. Thorax white; fore wing white, dusted with brown, shaded with orange toward apex and on fringe; costa irregularly edged with dark brown well toward apex, and with some smaller, ill-defined, brown spots. 7.5 mm.

July.

Northern New Jersey.

2. **M. bipunctella** Dietz. White; shoulders black; dark costal shading forming only two projecting waves.

Florida; Ohio.

17. *TRIPTODEMA* Dietz

Fore wing with normal venation, all veins free; hind wing lanceolate, the costa not sinuate, with M primitive, three-forked, with no cross-vein between the forks, but one present between M_3 and Cu. Fringe nearly twice as wide as membrane. Ovipositor membranous.

This genus apparently is related to Hybroma.

1. **T. sepulchrella** Dietz. Dark brown, dusted with yellow, the yellow dominant on the thorax. Head russet. Fore wing with yellowish streaks in cell and fold, cut by the dark brown discal spots. A large dark brown spot near base. 8 mm.

August.

Plummer's Island, Maryland.

18. *XYLESTHIA* Clemens

Head wholly rough, palpi with third joint very thin, half as long as second; second joint with a large brush of hair as in Amydria. Antennæ two-thirds as long as fore wings, as in Tinea, with a very heavy pecten. Wings as in Amydria, narrower, with rough scaling and scale tufts.

1. **X. pruniramiella** Clemens. Dull pale brown, usually with paired paler striæ and the scales largely black-tipped; sometimes nearly immaculate or with a darker shade through the middle. Fringe barred in var. **kearfottella** Dietz. 12–15 mm. (*congeminatella* Zeller, *clemensella* Chambers).

The moth is locally common from May to August. The larva is dirty white, with a brown head and cervical shield. It mines in woody excrescences on plum. The cocoon is made of frass and is placed near the mouth of the burrow. April and May.

New Hampshire to Georgia, Kansas and Texas. New York: Ithaca, West Farms.

19. *AMYDRIA* Clemens

(*Myrmecozela* Meyrick, in part)

Head rough, though less so than usual in the Tineidæ, with short flattened hair. Antennæ whorled with scales, half as long as fore wings, pecten absent. Tongue and maxillary palpi very small; the latter porrect; labial palpi upturned to vertex with a spherical tuft on the second segment; the third segment about as long, and slender. Venation like that of Tinea.

Almost all the moths are identical in pattern, and are light straw yellow with brownish markings and reticulation; but they differ widely in the male genitalia. The figures show the outline of the valve as shown by denuding.

FIGS. 99–100. RIGHT VALVES OF MALE GENITALIA OF SPECIES OF AMYDRIA

99, *A. effrenatella;* **100**, *A. brevipennella* (from co-type in the United States National Museum)

I. Head rougher, third segment of palpi compressed laterally (Amydria).

1. **A. effrenatella** Clemens. Fuscous shading usually forming a discal patch extending obliquely down and basad into the fold, a shade in the fold near the base, spots about the outer margin, and a shade along the inner margin. 15–25 mm.

The male uncus ends in two long spines, the valve has a moderate spine on the ventral edge (fig. 99).

June and August.

Massachusetts and Parry Sound, Ontario to New Jersey, Missouri and Pennsylvania. New York: Ithaca.

2. **A. brevipennella** Dietz. Tuft on palpus smaller than in *A. effrenatella;* moth usually paler with light reticulation, leaving the marginal spots and discal patch strongly contrasting; sometimes differing from small specimens of *A. effrenatella* only in structure. 14–15 mm.

The male is easily distinguished by the absence of the spine on the lower edge of the valve. The uncus is only slightly cleft (fig. 100). A blackish variety of this species is known.

Maryland; District of Columbia; Virginia.

II. Head smoother; vestiture of front less prominent; third segment of palpus flattened from front to back (Dysmasia *Herrich-Schœffer*).

3. **A. dyarella** Dietz. Gray to dark fuscous brown, inner margin with distincter

markings, fringe with nine dark bars. Dark markings contrasting and clean-cut on a nearly evenly colored ground, tending to be transverse. 13–15 mm.

I have not seen this form, and nothing has been published as to its structure. It was taken at Hazelton, Pennsylvania. It is darker than any of a large group of related southern species.

Pennsylvania; Maryland.

20. *SETOMORPHA* Zeller

(*Semiota, Apotomia* Dietz)

Head smoothly scaled, palpi moderate, ascending, flattened, second joint thickened with scales, and with lateral setæ; tongue and maxillary palpi obsolete. Wings rather narrow, ovate-lanceolate. Fore wing (fig. 79) with a more or less hyaline fovea in the accessory cell, which is not wholly separated from the discal cell, the fovea distorting the venation in both sexes; R_3 to R_5 stalked, Cu_1 and Cu_2 united in male, stalked in female. Hind wing with costa sinuate, **Sc** short, M_1 and M_2 stalked, M_3 and Cu_1 united in male, separate in female. M_3 and Cu_1 of fore wing stalked in some specimens, in others, free. Fovea with fine spinules on the wing-membrane, which may represent aculeæ.

1. **S. insectella** Fabricius. Dull luteous, dotted with light gray-brown. 8–20 mm. (*operosella, inamœnella, ruderella* Zeller; *multimaculella* Chambers, *majorella, sigmoidella, transversestrigella, fractilineella* Dietz).

If the species occurs at all in the northeastern States, it is a stray. It is an important pest of stored food in the tropics.

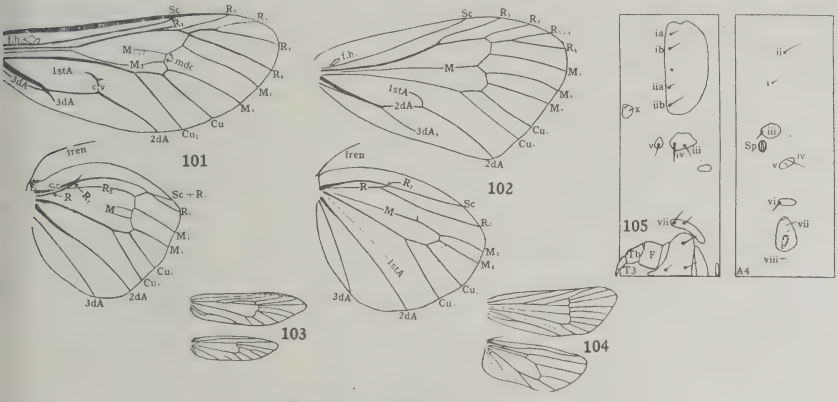
Family 10. **PSYCHIDÆ**

(With Tineidæ, in part)

Mouth parts typically all rudimentary, the palpi usually reduced to hairy tubercles, and the rest lost; a little more developed in Kearfottia. Head with loose, hairy vestiture, that on body variable; ocelli absent, with rare exceptions. Eyes small and retracted, often nearly buried in vestiture; antennæ moderate to very short, in higher forms broadly pectinated, with scaling irregular and confined to the upper side; in the lower forms with the normal two whorls and some bristles.

Abdomen of female ending in a bushy tuft, whose hairs are mixed with the eggs. Legs short, and in higher forms, hairy, the spurs tending to disappear. Typically with more or less translucent or transparent wings. Fore wing with base of **M** quite distinctly preserved and often forked; **Cu** apparently 2- or 3-branched; accessory cell separated from cell by a fine vein, or fused with it as in other Tineoids, R_5 always running to outer margin, near apex. At least the middle portion of **1st A** preserved, often connected to **2d A** by a crossvein or running into **2d A**; **3d A** free at base and quite strong; usually with the tip very distinctly forked, and the upper fork joining **2d A**. Hind wing typically with R_1 full developed, running across to **Sc**, often with tip of **Sc** free, and often with an anastomosis between **R** and M_1 farther out; two or three anals, none distinctly forked at

ase.. Very often a few veins are lost, or there may be secondary eins developed, especially in the costal region of both wings, making ıe homologies uncertain. The foregoing description applies fully only



FIGS. 101–105. PSYCHIDÆ

101, *Thyridopteryx ephemeræformis,* male venation; **102,** *Eurycyttarus conderata,* male venation; **103,** *Solenobia walshella,* male venation; **104,** *Kearfottia Ibafasciella,* venation; **105,** *Thyridopteryx ephemeraformis,* seta map of larva

ɔ the males of the more specialized genera; in the lower ones, the enation is as in the Acrolophid Tineidæ, from which only the tufted bdomen of the female, and small first segment of palpi seem to differntiate them in the adult. The females in the lowest forms are much like ne males, except for the abdominal tuft; but in the higher, they gradally become reduced till in the most specialized genera the female is ıaggot-like, without recognizable structures, and with only the peristent abdominal tuft to show that it belongs to the Lepidoptera. 'hese last forms never leave the pupa shell, but are fertilized within ne cocoon by means of the long extensible abdomen of the male, and ay their eggs within the empty pupa shell, shrinking as they lay them. Even the lower forms that have preserved their legs and other appendges usually lay their eggs in or on the cocoon.

Eggs thin, of flat type, laid in a mass mixed with hairs. Larva (fig. 05) with the true legs strong, and the prolegs reduced practically to heir hooks, the prolegs all similar, with a single horse-shoe of uniordnal hooks, open on the inner posterior side, even the anals being pracically like the others. Head with adfrontals massive, typically not eaching much above top of front, the front never reaching the verex. Cervical shield large, surrounding the spiracle, which is lengthned horizontally; meso- and metathorax also with dorsal plates. Body

with setæ **i** and **ii** unusually variable in position, normal in lower forms, in higher with **ii** nearer the mid-dorsal line than **i**, or even directly above it; **iv** and **v** adjacent. All the known larvæ live in a movable case, with a large anterior opening for feeding, and a smaller posterior one through which the excrement is passed, through which the pupa emerges, and, in the higher forms, through which the extensible abdomen of the male is passed to fertilize the female. In the lowest forms the case is flattened and ellipsoidal (very likely so in Kearfottia), in Solenobia tending to be triangular, with a three-valved posterior opening, like that of many Coleophoridæ; in the Psychinæ fusiform, tapering strongly to each end and covered on the outside with bits of foreign matter.

Pupa with second segment of abdomen more or less movable, dorsal headpiece narrow and prothorax unusually wide for a Tineoid; antennæ short, broad in those species whose imagoes have pectinate antennæ; maxillæ rather quadrangular, not covering the labial palpi at all, exactly as in the Hepialidæ; the mandibles forming a distinct separate sclerite. Abdomen with each segment armed with an anterior row of spines and a posterior one of bristles; female pupæ of higher forms larviform, intermediate between the larva and grub-like adult in appearance, but brown and chitinized.

The family characters as given above are from the more typical specialized forms; the lower ones have not been fully studied, and show an intergradation to the lowest Tineoids, the pupæ having diffuse areas of spines dorsally. In spite of the wide variation, the European genera, which are many, form almost a perfect series from the lowest to the highest. The position of Kearfottia is doubtful, in the lack of knowledge of the early stages, but it seems related to the Lypusinæ, rather than to the Tineidæ or Yponomeutidæ. In many of its characters it is an exception to the definition of the Psychidæ, but the female has the characteristic, bristly anal tuft.

Subfamily **Lypusinæ**. Female winged. Palpi distinct; vertex in our species moderately roughened; antennæ practically simple. Fore wing (fig. 104) with R_5 running to outer margin, with all veins preserved, in our species with all free; accessory cell distinct, separated from discal by a fine vein; base of **M** in our species not forked. Cubitals rather short, and running squarely across to inner margin; **1st A** free, weak. Hind wing with R_1 appearing merely as a crossvein from **Sc** to **R**, cell much shorter on anterior side, the area above the base of **M** in our species quite small; with complete venation, or (in Kearfottia) with Cu_1 lost. Anal region a little reduced, though fully veined. Larva in a usually flattened case; normally a scavenger or carnivorous; pupa with cremastral spines dorsal. **Kearfottia.**

Subfamily **Talaeporiinæ**. Female wingless, but with normal eyes, antennæ, legs, and other appendages; leaving the cocoon for fertilization but laying its eggs within it. Male structure as in *Lypusinæ*, antennæ bristled; the fore wing in Solenobia with a vein lost (fig. 103). Case somewhat flattened, but with triangular valve; the larva feeding on lichens. **Solenobia.**

Subfamily **Psychinæ.** Female wingless, legless, and naked except for the terminal tuft; never leaving the pupal shell, or only after the eggs are laid; male antennæ pectinate; abdomen extremely extensible, conical when retracted; fore wing with all radials preserved or, rarely, one lost, often with a medial lost (by union of M_3 and Cu_1 ?), often with extra veins. Accessory cell not distinct, **1st A** connected to **2d A** by cross vein, or running into **2d A.** Hind wing with tip of Sc free, as a spur, the veins toward the margin variable and anastomosing, often with additional spurs, normal in Chalia; M_3 stalked with M_2 or lost. Larva of northeastern species in a fusiform case; with true legs shorter and stouter than usual, with ii higher than i on abdomen. Pupa with cremastral spines subventral (save in *Chalia rileyi*).

Male with transparent wings, hind wing subtriangular and small; fore wing more than twice as wide (fig. 101); abdomen conical. Larva with tubercle ii directly over i (fig. 105). **Thyridopteryx.**

Male with opaque, smoky wings, broad and ample, the abdomen hardly exceeding them (fig. 102); larva with tubercle ii on the annulet behind i. **Eurycyttarus.**

Male with translucent smoky, hairy wings, intermediate in width, the hind wing not lobed and relatively small. Fore wing with two veins lost, the rest free; **1st A** curving down into **2d A;** hind wing with seven veins, all free; the cell short in front. **Chalia.**

1. *KEARFOTTIA* Fernald

Front smooth, vertex with more or less rough scaling, leaning forward; much as in the Œcophoridæ; palpi oblique, reaching middle of front, second segment with long, loose hair-scales, third porrect; tongue minute; maxillary palpi scaly; no ocelli; antennæ rather less than half as long as fore wing, heavily ciliate, the cilia as long as the segments. Fore wing (fig. 104) elliptical, three times as long as wide; with complete venation, the veins from R_2 to Cu_1 nearly equidistant, Cu_2 a little more widely spaced, R_1 arising a third of the way out. Hind wing about half as wide, nearly semicircular, Cu_2 arising two-thirds way out on the cell, anals all present, **2d A** forked at base, sinuate, Cu_1 missing, **mdcv** unusually long and oblique, the simple base of M continued as M_{1+2}; **udcv** short, transverse. Female similar with a heavy body and large terminal tuft. Larva unknown.

The genus would fit almost as well in the Tineidæ (between the two subfamilies) or in the Yponomeutidæ (in the broad sense) as here, but the resemblance to Narycia and Diplodoma suggest a position near the foot of the Psychid series.

1. **K. albafasciella** Fernald. Head, thorax, and basal and apical thirds of fore wing deep brown; middle third cream white, usually with four dark spots along costal, and three along dorsal edge. ♂ 8 mm., ♀ 12 mm.

July.

Maryland; southern Ohio; Missouri (?).

2. *SOLENOBIA* Zeller

Characters of the subfamily. No ocelli, M_1 (?) lost (fig. 103), M_2 and M_3 stalked or connate; hind wing with M_2 and M_3 stalked. A small area of aculeæ near the base of cell. Female with a minute lanceolate rudiment of a wing.

The pupa is similar to that of Tinea, but the rows of spines are triple, rather than single; and the maxillæ are very short and widely separated, but have distinct maxillary palpi, separated by a suture. The antennæ are also shorter than in **Tinea.**

1. **S. walshella** Clemens. *Male* smoky; fore wing more or less contrastingly mottled and dusted with whitish; translucent. 12 mm. *Female* smoky black, rough, with sparse hair-scales.

The larva feeds on lichens on trunks of trees. The moth is not rare but is easily overlooked.

New York and south. New York: Ithaca, Bronxville (Woodruff).

3. *CHALIA* Moore

Antennæ short, broadly pectinate; abdomen conical and hairy, with large genitalia exposed at the end. Fore wing triangular, with costa rather straight toward base; apex rounded over, and inner and outer margins straight. Two anterior radials lost; R_4 and R_5 connate or shortly stalked, forking over the apex, M_2 and M_3 connate. Cu_1 and Cu_2 both arising from lower margin of cell. **3d A** running into **2d A.** Hind wing two-thirds as long as fore wing, but of only half the area. **Sc** free; cell narrow in front; all the veins widely spaced, and one medial lost.

The pupa has widely separated, quadrangular maxillæ and distinct mandibles, as in the Hepialidæ. The cremastral spines are nearly terminal but above the anus; the wings of the male less than half the length of the body, obsolete in the female. The abdominal segments have two toothed ridges. The case is nearly cylindrical but somewhat fusiform. It is 11 mm. long, and is covered with fine, dust-like material (lichens ?).

This description is drawn up from *C. rileyi*, which may prove to be distinct from the genus Chalia. It is more primitive than our other Psychinæ.

1. **C. rileyi** Heylaerts. Translucent smoky, without markings. 10–12 mm.

The larva is flesh color; its thorax yellow, striate with dark brown, and shining. The moth emerges in September.

Missouri; Jefferson County, West Virginia.

4. *EURYCYTTARUS* Hampson

(*Psyche*, in part)

Male antennæ very broadly plumose; tibial epiphysis quite small; one medial lost in both wings (fig. 102).

1. **E. confederata** Grote and Robinson. Smoky, the wings thinly but evenly scaled. 15 mm. (**H 41**:8; **1**:16, larval case.)

The larvæ feed on low plants, climbing up on the trunks of trees to pupate, in the early spring. The case is fusiform; less than 25 mm. long. It is covered with pieces of leaf, and so forth, running lengthwise, and, usually more than half as long as the case.

New York to Colorado and south. New York: Ithaca, New Baltimore, Staten Island; Newtown, Long Island.

5. *THYRIDOPTERYX* Stephens

Male antennæ broadly but stiffly pectinate, with simple, serrate apex. Hind wing rounded-triangular (fig. 101), extended at anal angle; wings transparent, except costæ and inner margin of hind wing.

1. **T. ephemeræformis** Haworth. Transparent and smoky. 25 mm. (**H 41**:12.)

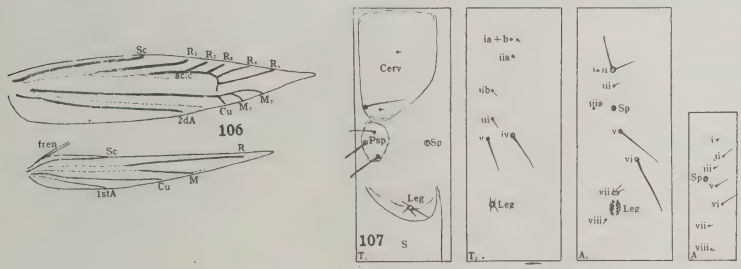
The larva feeds on various trees and shrubs, even arbor vitæ and other evergreens, and is sometimes injurious. The moths emerge in late fall, and the eggs hibernate. The case of the full-grown female may be nearly 50 mm. long; that of the male is always much smaller.

Connecticut to Florida. New York: Geneva (cases), Fort Edward, New Baltimore, Mt. Vernon, New York City, Staten Island; general on Long Island. Not hardy at Ithaca, but a pest on Long Island.

Family 11. TISCHERIIDÆ

(Tineidæ, in part)

Vertex with a rather smooth, spreading, flat tuft covering base of antennæ; front smooth-scaled, high, tapering strongly below. Ocelli absent; maxillary palpi obsolete; tongue weak, scaled; labial palpi smallish to minute, somewhat roughly scaled, but without bristles, not upturned. Antennæ with scape smallish, a third the width of the eye, with a small, modified, scaly pecten. Segments of shaft slender, and ciliate below, with outer whorl of scales perceptibly raised. Eyes large and naked. Hind tibiæ hairy, the upper spurs well toward base. Fore wing lanceolate (fig. 106) more or less caudate, with large discal and accessory cells and all veins arising from them short. All radials present; R_1 arising before the middle of the cell; R_5 running to costa; one or more dorsal veins lost, and those present very short; the last cubital running directly across to inner margin. Hind wing normally



FIGS. 106–107. TISCHERIIDÆ

106, *Tischeria*, venation; **107**, *Tischeria malifoliella*, seta map of larva

hardly half as wide as fore wing, in a few males about as wide, pointed; female frenulum of 2 bristles. Venation reduced and cell open.

Larva (fig. 107) less specialized than the Lyonetiidæ and Opostegidæ, strongly flattened; epicrania with an obscure lateral keel, with the normal setæ preserved, the epicrania extending a third their width behind the vertex. Hypostoma well developed, with divergent lateral sutures. Labrum with well developed pilifers; front reaching vertex, but sometimes narrowed to a point behind. Ocelli preserved, equal in size. Mouth parts small, normal. Mandibles of the biting type, the larva eating the parenchyma. Thoracic legs wanting. Abdominal segments slightly lobed laterally; prolegs with transverse bands of rudimentary hooks.

The larva is a leaf-miner, usually making a large blotch. Sometimes the feeding is all on one side, leaving the beginning of the mine

as a projecting point (trumpet-mine). The frass is ejected through a small slit in the leaf.

Pupa incomplete, of a low type, with segment 3, and possibly segment 2 free; fairly well chitinized. Setæ sometimes very heavy, i and i approximate on the movable segments. Dorsal spines fine, in one patch, or in two patches of spines of unequal size; sometimes with a row of larger posterior spines (oak species). Cremaster of two heavy upcurved hooks. Head with large dorsal piece; prothorax small; maxillæ long, nearly covering palpi; no maxillary palpi.

There appears to be only a single genus north of Florida. It is rather like the Tineidæ but the early stages are specialized for leaf-mining, and at the same time have some primitive characters.

1. *TISCHERIA* Zeller

(With *Coptotriche* Walsingham)

Characters of the family. In many species, the under side of the fore wing is clothed with many fine spinules that may represent aculeæ, but they are too coarse, and are more likely to be modified scales. Various sexual modifications of the wing are common, the most extreme form being that of *T. zelleriella*, in which the costa of the hind wing is notched, and the usual fringe replaced at the notch by fine, short bristles.

Key to the species

1. Nearly even dark gray.
   2. Scales evenly colored and quite purplish ..... 2. *aënea*
   2. Scales merely shining fuscous, with paler tips; a smaller species. 1. *malifoliella*, 3. *roseticola*
1. Fore wing powdered with blackish or with bands of powdering.
   2. Scattered small areas of black dusting ..... 6. *solidaginifoliella*
   2. Two oblique transverse fasciæ ..... 5. *heliopsisella*
   2. Heavily dusted all over ..... 4. *ambrosiæella*
1. Fore wing yellow, often broadly shaded with darker yellow, or with a very little brown dusting; larvæ on oak and chestnut.
   2. Hind wing of male as wide as fore wing.
      3. Male with apical fringe notched ..... 16. *zelleriella*
      3. Male with fringe normal.
         4. Hind wing regularly lanceolate ..... 15. *sulphurea*
         4. Hind wing widened at base, abruptly attenuate just beyond middle. 14. *clemensella*
   2. Hind wing of male half as wide as fore wing.
      3. Male with a fuscous patch near base of fore wing below, and less marked ones on both sides of hind wing ..... 12. *citrinipennella*
      3. Male without such patches.
         4. A patch of fuscous scales at anal angle of fore wing above.
            5. Vertex deep brown; fore wing pale lemon yellow, apex reddish or brown, sometimes dusted with black ..... 11. *badiella*
            5. Vertex concolorous; fore wing dull ochreous ..... 10. *tinctoriella*
         4. No such patch.
            5. Abdomen densely dusted beneath with fuscous brown on a pale yellow ground ..... 9. *castaneæella*
            5. Abdomen not dark dusted.

6. Fore wing dull ochre.....8. *concolor.*
6. Fore wing reddish yellow, margined with purplish fuscous.
7. *fuscomarginella.*
6. Fore wing pale straw yellow, with dark-dusted spots.
13. *albostraminea.*

1. **T. malifoliella** Clemens. Mouse gray, a little shining, the scale-tips showing some golden iridescence. 6 mm.

Larva on apple, starting in a linear mine, which is gradually widened into a large blotch; but is not tentiform until the formation of the cocoon, when a fold is made, to contain the pupa. Larva in August; moth in May.

This moth, the "trumpet-miner", is generally distributed.

New York: Menands (Albany Co.), Schenectady, East Greenbush. The larval work is seen throughout the State, but I have seen no records.

2. **T. aënea** Frey and Boll. Similar to *T. malifoliella*, rather larger, distinctly brighter and more purplish, with strong bronzy iridescence and purple apex; the hind wing rather more nearly concolorous. 7 mm.

The larva occurs on Rubus. The mine is generally straight, and runs to the edge of the leaf, usually between two veins. The mine is crumpled in parallel folds, much like that of the oak-feeding species and Lithocolletis.

Massachusetts; Ohio; Pennsylvania; Texas.

3. **T. roseticola** Frey and Boll. Indistinguishable from *malifoliella* in the adult stage, but usually a little smaller, duller, with broader wings, slightly more roughly scaled toward the apex, and with a yellower face.

The larva is a trumpet miner on rose.

4. **T. ambrosiæella** Chambers. Head powdery dull brown; fore wing luteous, heavily dusted with blackish, showing traces of the transverse bands of *T. heliopsisella*, the dark markings leaving two or three lightly dusted and more distinctly yellow areas toward the outer margin. Fringe mouse gray with some black-tipped scales. Hind wing mouse gray. 6 mm.

The larva mines *Ambrosia trifida* and does not form a nidus.

Kentucky; Ohio; Missouri.

5. **T. heliopsisella** Chambers. Deep ochre yellow. Fore wing with two oblique gray fasciæ from a third way out on costa to middle of inner margin and from beyond middle of costa to three-fourths way out on inner margin; a costal streak from the latter to the apex, and a streak in base of fold; all the black dusting a white ground. 8 mm. (*nolckenii* Frey and Boll).

The larva occurs on Heliopsis and Ambrosia, in August. It spins a circular white nidus for shelter within the mine, and pupates in it.

Southern Ohio; Kentucky; California.

6. **T. solidaginifoliella** Clemens. Cream color or light straw yellow; shaded with bright yellow, becoming yellow-brown in the costal fringe. Head solid yellow; fore wing with scattered spots of black dusting. 7 mm.

August. Larva in a flat, white blotch on upper side of leaves of Solidago.

Pennsylvania to Texas. New York: Albany.

7. **T. fuscomarginella** Chambers. The larva is a miner on the under side of oak leaves.

Kentucky.

8. **T. concolor** Zeller. This species is known only from Texas. The mine is at the edge of a leaf of oak.

9. **T. castaneæella** Chambers. Pale yellow, all the margins of the fore wing strongly shaded and dusted with yellow brown; the under side of the abdomen contrastingly dusted with dark brown except at the apex. 8 mm.

The larva forms a narrow blotch mine along the edge of a leaf of chestnut. I have never seen a male.

Virginia; Kentucky.

10. **T. tinctoriella** Chambers. Dull ochre, the margins noticeably dusted wit dark-brown, darker than *badiiella*. Fore wing of male gray-scaled below, excep at the apex and below the fold. (*quercitella* Clemens).

Larva in a blotch-mine on the upper side of an oak leaf, the mine extending ou into lobes and marked with zigzag purple lines.

Kentucky; Missouri. New York: Albany (New York State Museum).

11. **T. badiiella** Chambers. Light straw yellow, with contrasting, dark-brow vertex; apex of fore wing usually dusted with black (var. **pruinosella** Chambers typically with the two dots only; fore wing more or less tawny-shaded from ana angle to apex. A small dark spot two-thirds way out on costa as well as th one on the inner margin. (*citrinipennella* Walsingham, not Clemens; *purinosella pruinosella* Chambers).

The larval mine is a crumpled blotch on oak like that of *T. zelleriella*. The mot occurs in August and in March.

Quebec to Texas.

12. **T. citrinipennella** Clemens. Yellow; head and thorax yellow-brown; costa and apical third shaded with yellow-brown; fringes much paler and duller. Hin wing whitish, becoming umber brown at base. Abdomen dusted with brownish yellow below, but much paler than in T. castaneæella. 8 mm. (*quercivorell* Chambers; *fuscomarginella* Walsingham, not Chambers.)

Mine on oak; crumpled like that of *T. badiiella*. Moth in August.

Pennsylvania; Ohio; Missouri. New York: Crosby (Yates Co.), Ithaca.

13. **T. albostraminea** Walsingham. Pale straw color, not shaded with ochre with blackish-dusted spots two-thirds way out on costa, five-sixths way out o inner margin, and over the apex, the latter the strongest. Apical fringe dee ochre. Underside pale with deep-ochre apical fringe. 5 mm.

The larva forms a small blotch on white oak. The moth emerges in August It is our smallest species.

District of Columbia; Kentucky. New York: (type).

14. **T. clemensella** Chambers. Yellow, costal edge and some dusting toward apex below browner. Basal half of fore wing, below, with yellow sex-scaling (*bicolo* Frey and Boll).

Texas.

15. **T. sulphurea** Frey and Boll. Texas. This moth is unknown to me.

16. **T. zelleriella** Clemens. Light ochre, with a deep yellow shade in fringe ove apex, costal fringe of hind wing brown, dorsal pale. Hind wing whitish in the male, gray in the female. Under side of fore wing with long, stiff hair, extending obliquely up from near inner margin, nearly across to costa, and from base three fifths length of wing; cell clothed with dense fine scales. 9 mm. (*Coptotriche* Wal singham; *complanoides* Frey and Boll; *latipennella* Chambers).

The larva makes a trumpet-mine on oak, and is unique in Tischeria in leaving its frass within the mine in a series of curved lines. The moth occurs generally i March and April.

Distribution general.

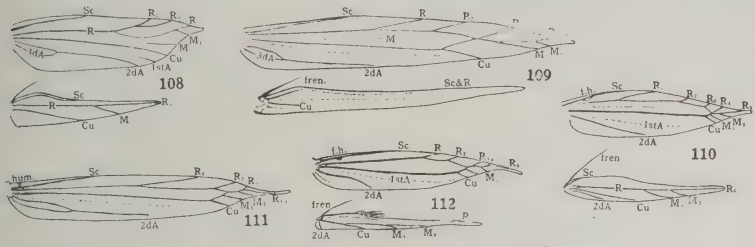
New York. (Henry Edwards.)

Family 12. **LYONETIIDÆ**

(Tineidæ, in part)

Vertex either hairy or scaled; face smoothly scaled, strongly oblique; tongue weak and naked or obsolete; maxillary palpi usually obsolete; more rarely quite short, straight, and drooping; labial palpi short and scaled, drooping or obsolete, best developed in Phyllocnistis, which only

doubtfully belongs to this family. Ocelli absent. Antennæ with scape enlarged and flattened; with eye-cap except in a couple of species of Phyllocnistis. Shaft with two nearly equal whorls of scales to a segment. Hind tibiæ with long bristly hair above, becoming a row of strong bristles in Phyllocnistis; upper spurs attached well above the middle. Fore wing lanceolate, often caudate (with a slender prolongation of the apical membrane), $\mathbf{R}_5$ running to costa; radials often reduced to three; $\mathbf{R}_1$ leaving cell well toward base of wing, except in



FIGS. 108–112. LYONETIIDÆ

108, *Paraleucoptera albella*, venation (after Heinrich); **109,** *Bedellia somnulentella*, venation; **110,** *Bucculatrix*, venation; **111,** *Lyonetia*, venation of fore wing; **112,** *Phyllocnistis*, venation

Phyllocnistis, or lost. Not more than four dorsal veins. Vein **1st A** weak, free; **2d A** variable, even within the genus Cemiostoma. Hind wing linear or lanceolate, its fringe much wider than itself, the membrane abruptly narrowed near or before middle of costa. **Sc** short, running close to costal edge, or even fused with it; sharply divergent from the R-stem from the base as in the Elachistoidea; R-stem running to apex, with one or two medials given off from its lower side; **Cu** separate, simple except in Philonome; anal region extremely reduced, often without distinct veins.

Egg flat. Larva with both true legs and prolegs present; 16 legs, except in Phyllocnistis. Body nearly cylindrical. Head much flattened in the normal series, with strong lateral keels and reduced mouth parts. Ocelli, six, in two groups; some setæ lost. Front quadrangular; hypostoma as in the Tischeriidæ. Setæ **iv** and **v** on abdomen remote, **i** nearer the middle line than **ii**; setæ of prothoracic wart widely separated; setæ of prolegs uniordinal in a complete ellipse; rarely with traces of a second row.

Pupa with all appendages soldered together and no free segments; labial and maxillary palpi not visible; labrum a separate sclerite; appendages nearly as long as the body; antennæ longer than wings; prothorax narrow, especially on the middle line, the dorsal head piece

wide. Spiracles small, circular and slightly projecting. Dorsum o abdomen not spinulated.

The larvæ and pupæ of Bucculatrix and Phyllocnistis are aberran and are discussed under their genera.

The family is somewhat heterogeneous and has been divided by som into four or five, in fact one for each really well-marked genus. Buc culatrix is quite isolated, but its imago agrees with the characters o the family, while Phyllocnistis is practically half way between th Lyonetiidæ and the Gracilariidæ, showing a mixture of the character of both in all stages. European workers tend to separate a Lyoneti group from a Cemiostoma (Proleucoptera) group, but there are Nort American genera which connect the two so well that subfamilies ca hardly be made.

Key to the genera

1. Vertex rough, bristly, contrasting with lower face.
  2. Eye-cap edged below with a row of strong bristles; cell entirely above middl of wing; wing with a scale-tuft at middle of dorsal margin.
    3. Front running down far below eyes in a blunt point.....7. **Bucculatrix**
    3. Front short .....8. **Philonome**
  2. Eye-cap smoothly scaled; cell central in the wing, which is smoothly scaled.
    3. Four veins running from cell to inner margin.
      4. Hind wing with **R**, **M**, and **Cu** represented by 5 veins.....1. **Corythophora**
      4. Hind wing with **R**, **M**, and **Cu** represented by four veins..2. **Proleucoptera**
    3. Three veins from cell to inner margin (figs. 109, 111).
      4. Vertex with a small, fine tuft.....4. **Lyonetia**[13]
      4. Vertex and upper part of front extremely rough.....5. **Bedellia**
1. Entire head smooth.
  2. Palpi moderate; tongue obsolete; eye-cap tending to disappear; fore wing with lanceolate discal cell and no accessory cell (fig. 112)...6. **Phyllocnistis**
  2. Palpi minute; tongue present in our species; accessory cell present, but open outward so that R_2 and R_3 are stalked together; hind wing broader, lanceolate (fig. 108).....3. **Leucoptera**

1. *CORYTHOPHORA* Braun

Face smooth, with an erect tuft between antennæ; antennæ four-fifths as long as fore wing; eye-cap pointed anteriorly below; palpi moderate, smooth, drooping; maxillary palpi rudimentary. Fore metatarsi thickened with scales; hind tibiæ hairy. Fore wing sublanceolate; R_1 absent, R_2 and R_3 as in Cemiostoma; cell with four posterior veins; tip of **1st A** distinct, **2d A** simple; hind wing lanceolate, two-thirds as wide as fore wing; veins obsolescent at base; cell open both above and below **M**; **Cu** forked; anal region reduced.

1. **C. aurea** Braun. Golden yellow; head and appendages very pale, projecting point of eye-cap rather darker; thorax nearly white, with golden tegulæ; fore wing becoming deep orange at apex; middle of costal and dorsal margins fading to white; fore tibiæ and tarsi dark brown externally. 9–9.5 mm.

July.

Southern Ohio; Balsam, North Carolina.

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[13] The Gracilariid genus Leucanthiza is likely to run to Lyonetia but is distinguished by its less perfec eye-cap, moderately developed palpi, and orange coloring.

2. *PROLEUCOPTERA* Busck

(*Leucoptera; Cemiostoma,* in part)

Face smooth; vertex with a small fine tuft; antennæ four-fifths as long as fore wing; eye-cap good-sized, rounded, with regularly imbricated scaling, less perfect than in Opostega. Palpi small, drooping; tongue weak but distinct. Fore wing broad, with lanceolate, caudate membrane, with 10 veins, all separate, **2d A** forked at base, M_3 and R_4 absent; hind wing narrow, without cell, with M_3 and Cu_1 absent; fringe four times as wide as membrane.

This genus is very closely related to Leucoptera (Cemiostoma) but is slightly more primitive.

1. **P. smilaciella** Busck. Similar to *C. albella;* larger; first fascia much narrower, three times as long as wide, strongly oblique, and starting nearer the base; the second fascia a mixture of yellow and white, ending outwardly in four dark lines that converge on the apex; lead-colored spot smaller than in *C. albella,* and completely surrounded before and above with the yellow band.

The moth has been obtained from June to September. The mine is a large, dirty upper-side blotch on Smilax, beginning as a line. The cocoon is formed on the leaf, under two bands of silk.

Maryland; District of Columbia; southern Ohio; Pennsylvania.

3. *LEUCOPTERA* Hübner

(*Cemiostoma* Zeller)

Head smooth, with the usual large, vertical scales on occiput only. Eye-cap well developed, apparently continuous with the head vestiture, when closed completely covering eyes; mouth parts obsolete. Hind tibiæ with bristly hair; fore wing oblong-lanceolate, caudate; R_1 weak or absent. Only three veins running from cell to hind margin, M_{1+2}, M_3+Cu_1, and Cu_2; hind wing linear-lanceolate.

In the American species (subgenus **Paraleucoptera** Heinrich,) R_2 and R_3 are stalked, R_5 stalked with **M**, but very short, and **2d A** is forked at the base in the fore wing; the hind wing has only one medial. Typically, R_3 and R_5 are lost, and **2d A** is simple, but there are two medials in the hind wing.

1. **L. albella** Chambers. Sometimes with a few hairs to represent vertical tuft. Snow white; antennæ pale fuscous with white eye-cap and apex; fore wing with a nearly square golden fascia from costa beyond middle, pointing toward anal angle; a larger spot on costa beyond it, reaching apex, sometimes broken into fasciæ, both of which are edged with brown; and a silvery gray spot near anal angle, preceded and followed with black spots; with a yellow line before it, preceded by fuscous-tipped scales. Fringe fuscous at apex and anal angle, paler between. 6 mm.

Larva flat, lobed at sides, with pro- and mesothorax widest, then a couple of relatively narrow segments, and abdomen wider again, with minute but normal legs.

It lives, often socially, in a very dirty frass-filled mine, on poplar and willow. The cocoon is like that of *P. smilaciella.*

Kentucky; Colorado and west.

4. *LYONETIA* Hübner

Vertex with bristling hair, intermediate between Proleucoptera and Bedellia and Bucculatrix. Antennæ with a strongly developed eye-cap, about as long a fore wings; palpi longer than eye, drooping, divergent; maxillary palpi minute tongue obsolete. Hind tibiæ with long, sparse hair. Fore wing narrow-lanceolat (fig. 111), caudate, with R_1 arising from near middle of cell, cell narrow, withou accessory cell; with 4 to 6 veins arising from near its tip; **2d A** strongly forke at base. Hind wing linear, with M_1 and M_2 arising out of **R**, M_3 lost, and **Cu** simple

The larva normally makes a linear mine. Spuler puts Lyonetia as a separat family from the preceding and following genera; but its characters do not seen very important. The imago hibernates under bark.

Key to the species

1. Light brown with longitudinal white streak ..... *saliciella*
1. Ground white.
   2. No distinct yellow area at apex ..... 1. *speculella*
   2. A large, orange-yellow patch at apex ..... 2. *latistrigella*

1. **L. speculella** Clemens. Shining white; antennæ dark brown above, more or less annulate, paler below; palpi fuscous outwardly; hind wings and fringe also a narrow band on hind edge of fore wings, mouse gray, bronzed with purple A brown streak from base along costal edge to beginning of fringe, typically very weak; the streak then running obliquely to inner margin, enclosing a white spot at inner margin. Another longitudinal bent streak in the middle of wing, meeting the transverse part of the first; beyond this an orange-yellow spot. A black apical dot. Fringe with three bars on costal side and one below, or sometimes with five costal and three dorsal streaks. Typically with blackish bars at middle and three-quarters way out, below fold. The type form is fully marked, but var. **gracilella** Chambers more lightly. 7 mm. (*gracilella, apicistrigella* Chambers, *nidificansella* Packard).

The moth hibernates under bark. The larva occurs on grape, and, when common, on many other trees and shrubs. The mine at first is linear, with the frass left in it; then it abruptly changes to a blotch, and the frass is then ejected through a hole. The cocoon is slung like a hammock on the back of a leaf. I have seen a specimen of the moth suffused with gray.

The distribution is probably general; I have seen it from Pennsylvania to British Columbia.

2. **L. latistrigella** Walsingham. Similar; fore wing with a fascia running from middle of inner margin to three-fourths way out on costa, followed by a ferruginous patch; without the costal streak of *L. speculella;* apical black dot preceded by white scales. 9 mm.

Larva in soft young leaves of *Rhododendron maximum;* mine at first linear, 3 cm. long and black, then abruptly widening but still linear for 3 cm., then a brownish blotch about 5 mm. by 4 mm. Pupa naked, suspended by a few silk threads to a bent leaf.

Atlantic States (?) (locality not stated).

L. saliciella is known definitely only from the west but is to be expected in our territory; its larva feeds on willow.

5. *BEDELLIA* Stainton

Vertex and upper part of face with a large tuft of hair, smooth below; no ocelli; antenna with an extremely large, massive pecten, practically an eye-cap; tongue naked, weak; palpi small, hanging, appearing as if socketed in the face, as in the Heliodines group; maxillary palpi absent. Hind tibiæ with bristly hair. Fore wing narrow-lanceolate (fig. 109), not decidedly caudate, cell narrow, in middle of wing; four veins running from cell to costa and three (two in the Floridian *B. minor*) to inner margin; **A** forked at base. Hind wing nearly linear, with reduced obscure venation, and with very broad fringe.

The larva lives in a light web on the under side of the leaf of Ipomœa. I have not seen an adequate account of its structure, but it is less specialized than in the Proleucoptera group.

1. **B. somnulentella** Zeller. Dull light gray, sparsely and irregularly dusted with fuscous. 11 mm. (*staintonella* Clemens).

The moth has two broods, one occurring in August, and the second from mid-September to spring. The larva may be found from July to September.

This species is of general distribution in the northeast, and also occurs in Europe. New York: New York City (Lintner).

6. *PHYLLOCNISTIS* Zeller

Eye-cap variable in size, absent in *P. insignis*; no pecten; eyes small. Head smooth, palpi rather well developed; hind tibiæ with regular rows of long bristles. Fore wing caudate (fig. 112), with smallish cell and no accessory cell; R_1 arising well beyond middle of wing, R_5 running to apex; in some species all radials present; **A** short, not forked.

Feeding larva of the flat, Gracilariid type, with similar, very thin, blade-like mandibles and with hardly recognizable free portions of labium and maxillæ, but entirely without legs. Last-stage larva cylindrical; with rudiments of legs; with head practically reduced to a spinneret; not feeding. Mine serpentine, white or pale green, often shining (snail-track mine) with or without central frass-line; parenchyma not eaten, but only the sap. Pupa within the mine, in a partly folded edge of the mine; of Gracilariid, rather than Lyonetid type; rather heavily chitinized; antennæ and hind legs extending well beyond end of wings; segments 4 to 6 of abdomen movable and 7 in male, 3 fixed; segments 3 to 7 with dorsal pits near the anterior margin, and heavily chitinized setæ; segments 8 to 10 combined, shorter than 7.

The moth occurs in May, July, September and October.

The genus is as near the Gracilariidæ as the Lyonetiidæ, but is a little less out of place in this already rather heterogeneous family. Several entomologists make it the type of a separate family, Phyllocnistidæ. *Smilacisella*, once put in this genus, is a *Marmara*.

Key to the species

1. Ground color orange, larva on Compositæ ..... 1. *insignis*.
1. Ground color white.
2. A longitudinal golden streak from base to middle, connecting with the first dorsal fascia; larva on Magnoliaceæ.
3. Streak partly edged with black ..... 2. *liriodendrella*.
3. Streak not at all edged with black ..... 3. *magnoliella*.
2. No such streak.
3. Larva on sweet gum ..... 8. *liquidambarisella*.
3. Larva on poplar ..... 4. *populiella*.

3. Larva on grape or Ampelopsis.
4. Middle of apical region filled with a gray patch.....7. *ampelopsiella*
4. Middle of apical region white or golden.
5. Mine slender and broadly filled with frass.....5. *vitifoliella*
5. Mine broad, without central frass-line.....6. *vitigenella*

1. **P. insignis** Frey and Boll. Head and thorax lead-colored; fore wing orange; inner margin gray to middle, the gray area almost reaching costa at base, costal edge black, expanding into a black-edged, lead-colored triangle at middle; similar costal and dorsal lead-gray spots beyond middle; fringe black-barred. Sometimes with a little white in the costal black streak.

Larva on Erechtites. Moth in July and September.

Southern Ohio; Missouri; Kentucky.

2. **P. liriodendrella** Clemens. Similar to *populiella*. Apex broadly yellow; with a broad, yellow, longitudinal streak through middle of wing, joined by the tip of the oblique, postmedial streak; all markings finely edged with brown. 6 mm.

The larva makes a convoluted tract-mine, with a central frass-line, in the smaller terminal leaves of the tulip tree, in July.

3. **P. magnoliella** Chambers. Similar to *P. liriodendrella*; the brown edgings weaker, and absent from the basal streak.

Larva like that of the last species on various Magnolias.

4. **P. populiella** Chambers. White. Antennæ pale yellowish; eye-cap white; fore wing somewhat silvery; a dark gray, fine and broken, excurved postmedial fascia, with three slight dark bars in the fringe between it and apex. A strong black apical dot, from which extend two or three dark lines, in apical fringe; also an oblique streak before it in dorsal fringe; a slight, yellow shade before first fascia and at apex. 6 mm.

The larva forms a broad mine of the shining, snail-track type, but with distinct central lines of frass. It feeds on aspen and other poplars.

Apparently common and general in distribution, but rare in collections. New York: Hemlock Lake (bred).

5. **P. vitifoliella** Chambers. Similar to *P. populiella*; generally with black markings rather more distinct, the second fascia usually extending onto the wing membrane, and yellow areas rather less distinct. 4½ mm.

Mine on grape, like that of *P. populiella*, with quite distinct frass line.

Generally distributed; the commonest of the grape Phyllocnistises. New York (Beutenmuller).

6. **P. vitigenella** Clemens. Imago often indistinguishable from the other white species, but usually with a gray, antemedial shade on inner margin and with heavier and more extensive black markings; the second fascia, however, in the fringe only.

The mine is a narrow, almost invisible snail-track, without a frass-line; sometimes it is formed on Ampelopsis, and then is much contorted.

7. **P. ampelopsiella** Chambers. Similar to *P. populiella* and *vitigenella;* with bars heavier, and the postmedial one distinctly double; apical region with a good-sized gray area on dorsal margin, in which the costal dark streaks often end; and, in some specimens, with a distinct, longitudinal, gray streak on basal half, and gray antemedial patch. Yellow shading distinct.

Mine a narrow and much contorted tract, often fusing into a blotch; on Ampelopsis.

8. **P. liquidambarisella** Chambers. Moth like *populiella;* slightly variable; the markings typically reduced to a minimum, with hardly any yellow.

Mine of snail-track type without central frass-line; on sweet-gum.

7. *BUCCULATRIX* Zeller

(The ribbed-cocoon makers)

Head rough on vertex; front smooth, extending far below the eyes in a point. Antennæ not long, with a well-developed eye-cap, fringed with stiff hairs; labial palpi small, hanging; maxillary palpi minute; tongue very weak, naked, distinctest in the *niveella* group, which also spin atypical cocoons. Fore wing lanceolate (fig. 110) with cell mostly in upper half of wing. **Cu** running nearly through the center of the wing; with all radials; R_1 arising near base, oblique; the others running directly across to costa; **A** not forked. Hind wing also lanceolate, with broad fringe; with veins more distinct than in Bedellia, **R** running to apex; two medials preserved; **Cu** simple.

The larva at first forms a serpentine mine with a central frass-line, much like that of Nepticula; then leaves the mine, and skeletonizes the leaves, leaving one epidermis uneaten; it then lives exposed on the leaf.

Larva with head normal, the front extending about two-thirds way to vertex. Body cylindrical, stout, green; setæ normal, **iv** and **v** distant; **i** farther from middle line than **ii**, even on segments 8 and 9 of abdomen; prolegs strong, with two transverse bands of hooks (the anal pair as usual with a single row). True legs normal. Pupa in a silk cocoon, as a rule attached longitudinally to a twig; abdomen dorsally spinulated, with third segment free; a stronger row of spines on anterior edge of each segment. Labial palpi covered, hind legs much longer than antennæ; abdomen ending in a pair of laterally directed angles or spines.

The species are closely similar, and numerous, and may not always run correctly in the key; I have been obliged to omit a couple from lack of material. The cocoon is almost always spun in a characteristic way, so as to form longitudinal ridges with the silk threads in a regular pattern between them; in two or three species it is simply oval, with irregularly arranged silk. Bucculatrix is an aberrant genus, apparently nearest to the Lyonetiidæ, but with the larva modified for external life.

Key to the species

1. Fore wing, head, and eye-cap dominantly white or cream yellow.
   2. Cream yellow, with vague shaded markings; no black; very small, 4 mm. ..... 1. *luteella.*
2. Always with black in tuft or apical fringe, and usually in both.
   3. With black apical scales in fringe and a slightly yellow shade on vertex and wing-tip only ..... 5. *niveella.*
   3. With more extensive markings.
      4. Thorax white; fore wings brown, contrasting ..... 6. *errans.*
      4. Thorax yellowish, wings shaded with luteous.
      4. Thorax and ground color of wings pure white (the thorax rarely tinted with straw yellow).
         5. Expanse 8–12 mm., markings defined, pale yellow.
            6. Three costal streaks besides the brown apical shading ... 4. *montana.*
            6. Two costal streaks besides the brown apical shading.
               7. First costal streak most distinctly connected to anal angle. ..... 2. *magnella.*
               7. First costal streak turning longitudinally in middle of wing, second connected to anal angle ..... 3. *fusicola.*
         5. Smaller; markings brown, and when palest ill-defined; first streak free at tip, second parallel to it and sometimes running to anal angle.
            6. Markings blurred, yellowish; apical dot circular, followed by two bars ..... 11. *albicapitella.*

6. Markings clean-cut, gray-brown; apical marks broken up.
7. Scales in outer transverse band all more or less bicolored duller brown.....8. *agnella*
7. Scales in outer band black-tipped toward costa but evenly colored toward inner margin.....10. *capitealbella*

1. Fore wing dominantly brown or ochre yellow.
2. A white or silver basal dash.
3. Dash extending across thorax; ground brilliant yellow-brown. (*Philonome clemensella*)
3. Dash not extending across thorax; ground often dark brown. 21. *crescentella*
2. No defined basal dash; rarely with a pale longitudinal shade.
3. Light yellow-brown dominant.
4. Eye-caps mostly or wholly white; antennæ annulate; markings blurred; fore wing with basal third of the paler (lemon-yellow) color. 13. *packardella*
4. Eye-caps and white bands of fore wing with white, brown-tipped scales 12. *litigiosella*
4. Eye-caps usually yellow; white bands clear. Larger. Antennæ even yellow-brown; markings of fore wing defined and more or less silvery; basal third of the darker yellow-brown.
5. Tuft an isolated black spot.....14. *coronatella*
5. Tuft followed by an equally large, chocolate brown area. 15. *quinquenotella*
3. Fuscous-brown dominant.
4. Light; markings mainly of oblique streaks, and largely cream white. 17. *ambrosiæfoliella*
4. With an oval spot over and beyond tuft, and a similar one opposite it on costa; base mainly pale.....16. *pomifoliella*
4. Shining deep brown with yellowish-silver spots.
5. Six spots.....18. *canadensisella*
5. Only four spots.....19. *locuples*
4. Suffused powdery umber brown, the dorsal oval spot alone distinct and outlined with white; or with scattered white patches. 20. *ainsliella*

Not in key: *species C, copeuta, cuneigera, angustata.*

1. **B. luteella** Chambers. Cream white, most of head and eye-caps pure white; shaft of antennæ and vertex pale yellow; thorax and fore wing shaded with pale yellow, especially at middle and apex, contrasting with the white fringe. A very small tuft at middle of inner margin; no apical spot. 4 mm.

This diagnosis has been drawn up from the type at Washington.

March.

Kentucky.

2. **B. magnella** Chambers. White. A luteous band across eye-cap; fore wing with a luteous stripe from middle of costa to lower half of apex, sometimes extending farther toward base; another oblique costal streak meeting the first at outer end; and a streak at middle of inner margin, with some raised black scales at its inner end; scales toward apex with black tips. Costal fringe white; apical fringe brown, dorsal pale yellow toward apex, with two black lines of scale-tips. 8 mm.

The tongue and palpi are concealed by the overhanging face in this series.

June. Larva on Solidago; cocoon smooth.

Connecticut to Kentucky.

3. **B. fusicola** Braun. Near *B. magnella*; head with a few fuscous scales in middle of tuft; outer part, only, of antenna fuscous. Fore wing with longitudinal streak from base strong in female, weak in male; first costal streak more oblique

than second, its outer part longitudinal A line of black subterminal scales and a black line in fringe. 12 mm. (*magnella* in part of collections.)

Larva in a spindle-shaped gall on *Helianthus tracheliiformis*, located in the upper part of the stem; about 2 cm. long and 5 mm. wide. Cocoon grayish brown, smooth, and strongly flattened. Larva in September; moth from end of May to early July.

Cincinnati, Ohio.

4. **B. montana** Braun. Similar to *B. magnella* and *B. fusicola*. Vertex with some fuscous scales; shaft of antenna all gray. Fore wing with *three* oblique streaks from the costa, parallel and equidistant, besides the dark apical shading; the first two streaks confluent below. 11 mm.

June.

Mountain Lake, Virginia.

5. **B. niveella** Chambers. White; slightly yellowish at tip of wing and vertex; fore wing with some black scales in costal fringe, and two lines in dorsal fringe only.

Magnella is probably a fully marked variety of this; in fact I have seen intermediate specimens, bred from Solidago.

Kentucky. New York: Rock City (Cattaraugus County).

6. **B. errans** Braun. Head and thorax white, brown in center; shaft of antennæ brown. Fore wing dark brown, with longitudinal white streaks at base above and below middle, leaving a brown longitudinal streak between them; two oblique white streaks on costa, the more basal heavier, and a white costo-apical spot in fringe; a streak, followed by two white dots, on dorsum. A dark line in fringe. Sometimes with the white streaks so enlarged as to dominate over the brown ground, and more or less fused. 10 mm.

Food *Aster shortii*. Larva forming a contorted linear mine in the fall, ending in an enlargement in which is spun a silken wintering cocoon. Larva in the spring boring in the tip of a growing shoot, killing it. Pupal cocoon whitish, with faint longitudinal ridges. Moth in May.

Cincinnati, Ohio; Okefinoke Swamp, Georgia.

7. **B. species C.** Head dirty white; eye-caps white; antennæ annulate, light dull brown and dirty white; fore wing whitish and dull light brown, with a quadrate, blackish patch in middle of fold; a short oblique brown shade before middle, extending narrowly along costa to base; another from three-fifths way out on costa, to outer margin above apex, ending in a black dot; and a subtriangular, costal subterminal patch; the bands broader than the distance between them; a contrasting, black, apical hook; tuft black, followed by a small brown area. 6–8 mm. (*ambrosiæfoliella* auct., apparently not of Chambers).

Doubtfully distinct from the next two species. Larva on Ambrosia; cocoon ribbed.

Kentucky; western Pennsylvania; Missouri; and elsewhere.

8. **B. agnella** Clemens. Bands powdery black on light brown, not strongly contrasting; anal dot reduced to a few scales. Head mostly white. 6 mm.

Kentucky; District of Columbia.

9. **B. copeuta** Meyrick belongs to this group. It was described from Ontario.

10. **B. capitealbella** Chambers. Antennæ annulate with yellow-brown; ground color pure white and markings brighter yellow-brown; no black scales at anal angle; first fascia not continued along costa to base. Otherwise like *B. agnella*.

I have seen the type.

11. **B. albicapitella Chambers.** Cream color, very sparsely dusted with fuscous, no brown; center of tuft and somewhat blurred bands on wing yellow. 5½ mm.

This is *luteella* of collections, but not of Chambers.

Kentucky.

12. **B. litigiosella** Zeller. Pale straw yellow; the scales of the ground tipped with contrasting dark brown; little or no brown on face; the brown more distinct

on eye-caps and very strong on the pale bands of the wing. Antennæ annula in yellow and two shades of brown; vertex yellow-brown. Fore wing with cos before middle, and a transverse median band yellow-brown, and some brov farther out; fringe with black-tipped scales in basal half, without lines. 6 mm.

Early spring. Larva on white oak.

Pennsylvania.

13. **B. packardella** Chambers. Head and eye-caps white; tip of vertical tu mixed pale golden and brownish; antennæ pale yellow, brown-dotted; thor white, brown-dusted; basal half of fore wing white, flecked with brown; a chron orange streak on fold and one on costa, spreading into the chrome-orange out half of the wing, which is more or less brown-powdered on the costa; a fai white streak from middle of wing to anal angle and one across apex beyond i fringe yellow, with two lines. 6 mm. (*trifasciella* Clemens, *obscurofasciel* Chambers).

Larva on chestnut, oak, and beech; moth in April.

The name *trifasciella* will have priority if it really represents this form.

Distribution general, extending west to California.

14. **B. coronatella** Clemens. Head with tuft pale ochreous, face yellowish whit eye-caps mainly pale yellow, more orange behind. Fore wings pale orange chro with a whitish patch near the base over fold, one nearly opposite and joined to on inner margin, and one near middle of costa; near tip, a whitish, transver band to middle of dorsal fringe; extreme tip whitish; the tuft and a blac dot at apex and line in fringe being the only black marks. 6 mm.

Larva on black birch.

Pennsylvania to District of Columbia, and vicinity.

15. **B. quinquenotella** Chambers. Pale straw color, the eye-caps palest, an wings darkest. Vertex brown-tipped; thorax yellow-brown, with straw-yello edges and tegulæ; fore wing straw color, the ground nearly covered by a broa antemedial, yellow-brown fascia, and confluent outer bands, leaving pale spot much as in *canadensisella*. Tuft with blackish scales followed by a chocola brown area; an oblique, pale gold subterminal streak from costa, preceded b chocolate brown; all the markings but the last and the tuft, very diffuse. 7 mm

This species has been bred from a ribbed cocoon on Ampelopsis.

16. **B. pomifoliella** Clemens. Head and eye-cap cream white, the tuft centere with brownish; antennæ pale ochreous, dotted with dark fuscous; fore wings crea white, dusted and shaded with brown; base with brown streaks on costa, fold and inner margin; patch on middle of margin large, oval; a streak from middl of costa to anal angle, ending in a black dot, broadest on costa; a dark brow apical spot, and a dark line in fringe across apex. 7 mm. (*pomonella* Packard *curvilineatella* Packard.) (H. p. 432 f. 251.)

Larva on apple in September; dark yellowish green with brown head, with dis tinct, dark hairs; with the usual habits; cocoon ribbed, on the twigs. The mot flies mostly in June and is generally distributed; common everywhere in New York.

17. **B. ambrosiæfoliella** Chambers. Head white, with discolored tuft; antenn annulated, dark brown and white; thorax ochreous yellow, faintly sprinkled wit brown (or with three yellow lines on a white ground); fore wings shaded, ochre ous and white; an oval, brown, scaled area on inner margin containing the tuft and edged with white; a short, brown, antemedial costal bar; a postmedial ba edged with white at the costa, extending across the wing to the anal angle, and along the outer margin to the apex; one slanting black line in dorsal fringe and some scales in dorsal fringe. 7 mm.

Kentucky.

I think I have recognized the species mixed with *B. pomifoliella*. It eats Ambrosia, but is not the better-known Composite-feeder (*agnella*?).

18. **B. canadensisella** Chambers. Similar to *B. pomifoliella*, but darker; head white; tuft centered with yellow-brown; thorax brown with a complete white

margin; fore wing brown, white at base; — the oblique, brown, antemedial area followed by a white fascia, interrupted at middle of wing and erect below, with the black tuft on its edge; white spots at middle of costa and anal angle; tending to join a streak from costa. Much like *augustata*, but wholly lacking the silver basal dash. A velvety brown apical spot, followed by a curved line in the fringe. (H. p. 431 f. 250.)

The larva feeds late in the autumn, in the usual manner on white birch, which it may disfigure badly; but it does little real damage because the leaves are almost ready to fall when it appears. The moth emerges in the spring.

This species is of general distribution south to Pennsylvania. New York.

19. **B. locuples** Meyrick. Blackish brown; head pale bronzy, with darker tuft. Fore wing with triangular golden spots at middle and near apex of costa; a larger transverse spot at middle of inner margin and a smaller spot at tornus. Hind wings dark; fringes gray. 7 mm. (Unknown to me.)

July.

Toronto.

20. **B. ainsliella** Murtfeldt. Blackish, heavily dusted on a dirty white base; vertex with fuscous tuft; eye-caps whitish, antennæ annulate. Fore wing with ground color very largely blackish; the pale parts outlining an oval, blacker patch on inner margin, parallel to whose upper, outer side there is a pale streak running down from the costa (*variabilis* Braun).

The larva normally feeds on black oak, and has the habits and cocoon usual in the genus; in an epidemic it attacks many trees.

B. ilecella Busck, a similar, holly-feeding species described from Texas, is to be expected in the range of its food plant.

21. **B. crescentella** Braun. Head whitish; some dark hair in tuft; fore wing ochreous or darker brown; basal dash white, faint in lighter specimens, extending to middle of wing, with a dark shade below it; a costal streak at middle of wing, oblique and concave outwardly; a less oblique streak three-fourths way out; with a darker space between the two; a white streak over an irregular black spot at apex; dorsal spot dark brown, edged with white. 7–9 mm.

The larva makes a trumpet mine, with a central frass-line, on aster, Solidago, and Erigeron, a single larva making several mines. But it never lives externally. The cocoon is normal, white. The moth flies in July.

Ohio to Toronto, Ontario, and New Hampshire. New York: Otto, Florida.

22. **B. cuneigera** Meyrick appears to be similar to *crescentella* but with the disc of thorax white. It was described from Ontario.

23. **B. angustata** Frey and Boll, of which *crescentella* may be a variety, is similar, with a white head and brown thorax, and a dark brown fore wing, with white markings. The thorax is typically white in *B. crescentella*.

8. *PHILONOME* Chambers

Hardly distinct from Bucculatrix. Face shorter, truncate below, exposing the drooping labial, and minute, folded maxillary palpi. Only one species known.

1. **P. clemensella** Chambers. Palpi, face, and eye-caps white, the latter with orange upper edge; antennæ reddish orange at base, the rest nearly white; thorax white, with broad pale orange area behind, and with orange spots on shoulders; fore wing reddish orange, with broad white streaks below costa and on inner margin, the latter extending to a small tuft of brown scales, then turning obliquely up and meeting the end of the other streak; an oblique streak from costa, two-thirds way out, extended along costa toward base. Apex dusted with dark brown; a brown hook in apical fringe, and two converging streaks in dorsal fringe. 8 mm.

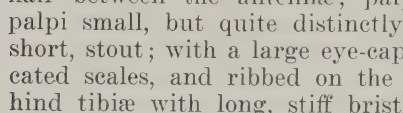
Larva on hickory and linden. Moth in July.

Northern New Jersey to Kentucky. New York (Beutenmuller).

Family 13. **OPOSTEGIDÆ**

(Tineidæ, in part)

Head covered with large, smooth scales, but with a strong tuft of lon hair between the antennæ; palpi small, without bristles; maxillar palpi small, but quite distinctly folded, tongue very small; antenn short, stout; with a large eye-cap, which is covered by regularly imbr cated scales, and ribbed on the inner side. Body small; middle an hind tibiæ with long, stiff bristles. Shaft of antennæ with a singl whorl of scales to a segment. Fore wing in the American species wit no branched veins (fig. 113); with four or five simple ones tending t join at base, only the one through the middle of the wing distinctl tubular. Aculeæ present but abnormal, pointing costad; arranged i regular rows, and confined to a small area about the base of wing Hind wing half as wide as fore wing, lanceolate; **Sc** and **Cu** simpl with a single, three-branched vei between them; frenulum a diffus tuft of bristles, somewhat concen trated in male, of a lower typ than is elsewhere known in th Frenatæ.



FIGS. 113–114.

113, OPOSTEGIDÆ, *Opostega salaciella* (Europe), venation; **114**, OINOPHILIDÆ, *Opogona aurisquamosa* (Hawaii), venation

Larva extremely slender, cylin drical, with the setæ apparently arranged in regular circles abou the body; legs wholly absent. Hea flattened, with thickened latera keels on the epicrania; setæ re duced. Front wider at back. Ocellus single, obsolete. Mouth part small and reduced; labrum modified and retracted into a notch in th clypeus, mandible thin, but of biting type, with a membranous process Dorsal part of head not extending far into thorax, but extended by a couple of heavy tendons; ventral side largely membranous, hypostoma rudimentary.

The larvæ mine in bast; the only known European species in flower stalks of Caltha, *O. albogalleriella* in Ribes. The pupa has not been studied.

The family is small, and almost entirely Oriental, where a couple of other genera occur, as well as Opostega. The relationships are quite obscure, but the group seems to represent, as near as anything, the point of origin of the Lyonetiidæ from the common Tineoid stem; as it shows characters that appear also in the Tineidæ, Nepticulidæ, Psychidæ and Lyonetiidæ. The family Oinophilidæ is hardly distinct, and some genera of the latter show a nearly complete, normal venation; the genus Opogona (fig. 114) is about halfway between the two families.

OPOSTEGA Zeller

Eye-cap very large, covering the base of the wings, as well as the whole side of the head, in repose; fore wing caudate, without forked veins. Larvæ bast-miners.

1. **O. albogalleriella** Clemens. Silvery white, with a minute black dot at tip of membrane of fore wing; apex of costa somewhat yellowish; two fine, dark lines in costal and dorsal fringes (*nonstrigella* Chambers, *accessoriella* Frey and Boll).

Var. **quadristrigella** Chambers has a gray shade near middle of inner margin.

The larva is a bast-miner on gooseberry and red and black currant. The mine often starts in a two-year-old stem and usually ends in it, running up and down the canes, and leaving a scar which is usually visible before the larva leaves the cane, late in June. The cocoon is seed-like and brown. It is spun in the soil, like that of Nepticula.

Massachusetts to Texas. New York: Otto, Geneva.

It is possible that *quadristrigella* is a distinct species; it may feed on Rancunculaceæ.

2. **O. cretea** Meyrick. White; three lines in costal and two in dorsal fringe; a minute black apical spot; an oblique gray dorsal spot at middle of wing. 8–9 mm.

Lake Muskoka, Ontario; July and August.

This species is unknown to me and indistinguishable from its description from *O. quadristrigella*.

3. **O. scioterma** Meyrick. Fore wing similar to *O. quadristrigella*, with an additional gray antemedial band nearly meeting the dorsal one, and a gray border. 9 mm. (Unknown to me.)

June.

Toronto, Ontario.

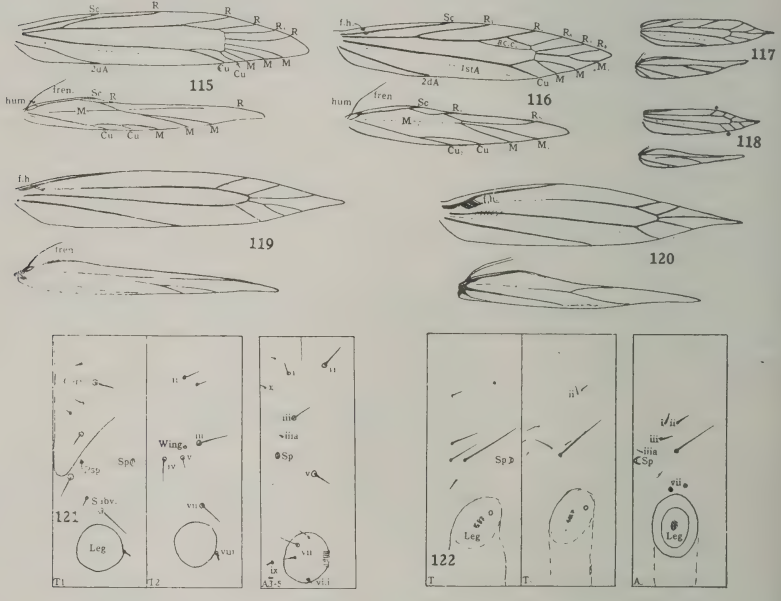
Family 14. **GRACILARIIDÆ**

(Tineidæ, in part)

Vertex either rough or smooth; face of the northern species smooth, at least below; ocelli usually absent; tongue well-developed; labial palpi moderate or long, often upturned, but usually with the third joint set on at a slight angle to the second, and the individual joints not noticeably curved; third joint normally blunt; no bristles. Maxillary palpi of porrect type, never folded across the front of the tongue, moderate to rudimentary, sometimes practically absent. Hind tibiæ normally smooth-scaled, often with a series of bristles above; the mid-tibiæ also bristled in some exotic species. Antennæ relatively long, often as long as fore wing, simple, with two full whorls of scales to a segment; eye-cap absent in our species.

Wings without aculeæ; fore wing lanceolate or linear-lanceolate, with lanceolate cell; the accessory cell rarely well-marked; **Sc** rather short, $\mathbf{R}_1$ arising before middle of cell, or absent, $\mathbf{R}_5$ running to costa (when recognizable); when stalked it is stalked farther with $\mathbf{M}_1$ than with $\mathbf{R}_4$ except in Cremastobombycia. The other veins short, and usually running sharply across to margin, part of them lost in the majority of forms. Apex of membrane very often drawn out in a long point, which rarely projects beyond the costal and dorsal fringe (caudate). **1st A** a well-marked fold, **2d A** simple, often strongly sin-

uous, without a trace of basal fork. Hind wing lanceolate (fig. 115 or linear, usually abruptly narrowing before middle; often wit strongly sinuous costa; the fringe much broader than the wing Frenulum of female with two bristles. Venation of the hind win usually more or less obscure, the veins being mere thickenings an



FIGS. 115–122. GRACILARIIDÆ

115, *Gracilaria alchimiella* (Europe), venation; **116,** *Parornix anglicella* (Europe venation; **117,** *Marmara salictella*, venation; **118,** *Leucanthiza amphicarpeæfoliell* venation (the asterisks mark inconstant veins); **119,** *Cremastobombycia solidagini* venation; **120,** *Lithocolletis emberizæpennella* ♀ (Europe), venation; **121,** *Acr cercops strigifinitella*, larva, seta map (after Heinrich); **122,** *Lithocolletis* speci (from maple), seta map

difficult to trace either in denuded dry wings or in stained one **Sc** and **R** closely parallel when the venation is best developed, an connected by what appears to be an oblique crossvein about tw fifths way out, which is much farther from base at its lower end **Sc** either stopping at that point or running well toward apex; reaching apex; $\mathbf{M}_1$ and $\mathbf{M}_2$ arising from radial stem, or connected t it by a short cross-vein; $\mathbf{M}_3$ from **Cu**-stem; cell always open betwee

M_2 and M_3, Cu_2 and either M_3 or Cu_1 apparently always preserved. The free tip of R_1 is preserved in primitive forms, apparently arising from the cross vein connecting **Sc** and **R**. Anal region obsolete.

The caterpillars (figs. 121, 122) always leaf (or bast) miners, at least when young, often changing their habits when part grown and forming nests in a folded leaf. *Young caterpillar* unique, specialized for feeding on the sap of the cells, which it opens with its blade-like mandibles; much flattened; lobed at the sides; widest near the anterior end. Head extremely flat; front widening toward the posterior end; adfrontals not normally recognizable, perhaps obsolete; maxillæ and labium very narrow as a rule, strap-shaped, and almost wholly incorporated in the head capsule, the free part of the maxillæ and labium minute. Ocelli reduced in size or number (frequently to a single pair). True legs sometimes absent; body-setæ much reduced, frequently unrecognizable, **iv** and **v** well separated; prolegs more or less reduced, often absent when the true legs are absent; hooks, when present, in one or two transverse or curved series, uniordinal, but sometimes with one of the series doubled. *Prolegs always absent on sixth segment of abdomen* (characteristic of the family). The caterpillar in this stage is always a miner, forming a more or less opaque mine (because the parenchyma is not eaten), which is often invisible from one surface of the leaf.

Full-grown larva strikingly different. Head but little flattened, with normal mandibles and maxillæ, and labium with spinneret. The bases of the maxillæ and labium long and slender. Prolegs always well developed on third to fifth and last segments of abdomen, but wholly absent on the sixth, the hooks as in the flat stage, but always more or less developed. Body cylindrical, with minute but recognizable setæ.

This type of caterpillar feeds on the parenchyma, either in an inflated mine, more or less lined and puckered with silk, or externally (skeletonizing the leaf) in a shelter which, in the typical forms takes the form of a cone, with the larger end closed by folding over the end of the leaf. In some species the cylindrical larva does not feed, but immediately spins the cocoon. The cocoon is usually of white silk, and is not woven in regular meshes. The mining species spin, as a rule, within the mine. The external cocoons of Marmara and some species of Acrocercops are ornamented with four groups of white bubbles, which are ejected as a froth through slits cut in the cocoon after it is spun; and soon set hard.

The change from one type of larva to the other takes place at different stages in different genera, and even in members of the same genus. In a couple of species of Acrocercops (**Neurobathra** Ely) the change is gradual, covering two or three molts.

Pupa incomplete, but specialized; derived from an early or pre tineid type. Vertex very large, prothorax wide at sides, much narrowed in middle; front often with a serrate cocoon-cutter; maxillary palp minute or absent; labrum well marked; antennæ and tongue long, the latter as long as the hind legs and extending free beyond the tip of the wings. Abdominal segments with fine, diffuse spining dorsally, without a specialized structure at anterior edge of middle segments dorsally; fourth segment of abdomen *fixed*, but eighth movable in male. Hibernation in imago or pupa, (in the latter case, with the imago well advanced inside).

The genus Phyllocnistis (fig. 112) might well be transferred to this family, but is markedly aberrant, especially in having preserved the legs of the sixth abdominal segment and in having lost the mouth parts in the cylindrical larva. The pupa is distinctly Gracilariid, but has abdominal segments 8, 9, and 10 much reduced, and peculiar dorsal structures on segments 3 to 7. The family as a whole is closely cognate with the Lyonetiidæ, indicating its Tineine derivation; but in its porrect maxillary palpi it shows relationship to the Yponomeutoidea and it is superficially convergent with the Lavernidæ.

Key to the genera

Moth

1. Hind tibiæ with a series of bristles above.
   2. Bristles fully formed; maxillary palpi (in our species) distinct. 3. **Acrocercops**
   2. Bristles imperfect, scale-like; maxillary palpi rudimentary..4. **Apophthisis**
   2. Bristles very strong, maxillary palpi rudimentary; antennæ often with eye-cap ..... (**Lyonetiidæ-Phyllocnistis**)
1. Hind tibiæ without series of bristles.
   2. Vertex with rough bristly hair.
      3. Fore wing with R_1 absent, first radial arising near tip of cell; maxillary palpi obsolete (figs. 119, 120).
         4. Fore wing with three veins running from cell to inner margin (fig. 119). 8. **Cremastobombycia**
         4. Two veins running from cell to inner margin. M_3 absent (fig. 120). 9. **Lithocolletis**
      3. Fore wing with R_1 present, arising from middle of cell (fig. 116); maxillary palpi conspicuous.....1. **Parornix**
   2. Head all smooth scaled (the scales somewhat erectile).
      3. Fore wing with R_1 absent (fig. 117).
         4. Maxillary palpi moderate .....6. **Marmara**
         4. Maxillary palpi rudimentary.....5. **Leucanthiza**
      3. Fore wing with R_1 preserved (fig. 115).
         4. Middle tibiæ thickened irregularly with rough scales.....2. **Gracilaria**
         4. Middle tibiæ slightly thickened at tip, or smooth; often with a little hair.
            5. Hind tibiæ smooth; fore wings with a definite pattern..7. **Parectopa**
            5. Hind tibiæ rough above; fore wings without markings. 4. **Apophthisis**

Pupa

1. Prothorax crested, and four times as long on sides as on middle line.
   2. Dorsum of abdominal segments with only one size of spines; the segments not crested behind.
      3. Spined areas the whole length of the segments.
         4. Tongue extending seven-eighths way to apex of fore wing or farther; spines obsolescent .....3. **Acrocercops** (*venustella*).
         4. Tongue one-third of the length of the fore wing; spines small but distinct ..... 5. **Leucanthiza.**
      3. Spined areas a fourth as wide as the length of the segments.
         4. Head without a prominent crest (cocoon cutter); tongue extending more than half way to apex of fore wing.....6. **Marmara.**
         4. Head with a prominent crest (cocoon cutter); tongue extending less than half way to apex of fore wing.....8 **Cremastobombycia.**
   2. Spines of two sizes; the posterior edge of the segments usually crested. 9. **Lithocolletis.**
1. Prothorax depressed and neck-like, not more than twice as wide on side as on mid-dorsal line.
   2. Spines very coarse, sometimes with fine ones intermixed.
      3. Head with a ventral cutting-plate, which is usually serrate; maxillæ as long as mid-legs.....2. **Gracilaria.**
      3. Head prominent, but without cutting-plate; maxillæ shorter than mid-legs .....1. **Parornix.**
   2. Spines very numerous and all minute.....7. **Parectopa.**

1. *PARORNIX* Spuler

(*Ornix* Treitschke, in part)

Vertex strongly roughened; front smooth; antennæ as long as fore wing, without pecten; palpi moderate, smooth; third segment somewhat shorter than second; maxillary palpi fairly large, similar to labials. Hind tibiæ smooth. Fore wing lanceolate (fig. 116); five veins running to costa, and four to inner margin; R_1 arising a third way out on cell; accessory cell usually preserved and R_5 and M_1 stalked. Hind wings narrow-lanceolate; tip of R_1 free but Sc coincident for a considerable distance with costal edge; venation nearly complete. M-stem usually forked; fringe three times as wide as membrane.

Larva of cylindrical type with normal legs (except when very young) with two curved bands of hooks, enclosing a straight row.

The larvæ leave their mine when well grown and form a nest by folding over the edge of a leaf, usually flatly. The pupa is formed in a similar nest. Most species feed on Rosaceæ and Amentiferæ. The moths rest with head raised, and fore and middle legs displayed. They fly freely in the afternoon. The species resemble each other closely, and are indeterminable if at all rubbed. The pupa hibernates.

Key to the species

1. Ground evenly brown, shining, with white or yellow marginal spots.
   2. A complete fascia; head concolorous.
      3. Five costal spots, outer half of apical fringe gray.....3. *preciosella.*
      3. Five costal spots followed by a white bar in apical fringe; longer fringe-scales at apex pale, and black-tipped.....2. *kalmiella.*

2. No complete fascia; head yellow.....1. *guttea*
1. Fore wing powdery gray or brown (Parornix).[14]
2. Fringe at apex pale tipped.
3. Palpus with third segment banded with dark fuscous.
4. Ground nearly even.....(4.) *innotata*
4. Inner margin whitish, contrasting with ground.
5. Expanse 10 mm.; inner margin with blackish spots at base and before anal angle.....6. *dubitella*
5. Expanse about 8 mm.; inner margin almost evenly pale. 5. *cratægifoliella*
3. Palpus with third segment bearing, at most, smaller fuscous spots.
4. Costal striæ regular.....9. *melanotella*
4. Outer costal stria stronger and more conspicuous.
5. Last stria complete, crossing both fringes.....7. *conspicuella*
5. Dorsal portion of last stria obsolete.....8. *arbitrella*
2. Fringe at apex black-tipped.
3. Palpus with third segment broadly, but often obscurely banded.
4. Lines in fringe stopping abruptly at apex; costal fringe with two white radiating bars, with a fuscous bar between them.....4. *anglicella*
4. Lines in fringe extending around apex.
5. Ground color of fore wing uniform.
6. A slight yellow tint on head and base of fringe of hind wing. 16. *inusitatumella*
6. No yellow tint.....10. *geminatella*
5. Ground toward inner margin mixed with white.
6. Plical spots not reaching inner margin.....11. *quadripunctella*
6. Plical spots large, reaching inner margin.
7. Costal striæ moderate, extending a third way across wing. 12. *vicinella*
7. Costal striæ much reduced, mere spots.....13. *sorbivorella*
3. Third joint of palpus with faint spots or none.
4. Fifth costal stria, counting from apex, forming a long oblique line running to anal angle.....14. *arbutifoliella*
4. Fifth stria not characteristic.
5. Ground practically uniform.....4. *anglicella*
5. Whitish areas on inner margin.....15. *obliterella*

1. **P. guttea** Haworth. First costal and dorsal spots opposite each other. Head and collar pale. Fore wing dark brown, with pinkish gloss; typically with four or more costal spots, but the outer ones sometimes minute, and two dorsal spots. Variety **solitariella** Dietz has the fourth costal spot large; three dorsal spots and a white sector in the fringe. 10–13 mm.

One brood, flying in May. Larva translucent, yellow, with black cervical mark only, as usual in Parornix; narrowly turning under the edge of a leaf; on apple.

New Hampshire to District of Columbia; westward to the Pacific.

2. **P. kalmiella** Dietz. Golden brown; the three dorsal spots farther out than the corresponding costal ones, and the one in fringe larger. 8 mm.

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[14]Maxillary palpi whitish; antennæ brown above, annulate, paler below; fore wing with numerous striæ, the costal striæ often more obscure toward base, and more oblique than the outer ones; last stria curved, usually crossing both fringes and enclosing a blackish apical spot; ground color toward costa usually dark; usually two antemedial and median dark patches (the plical spots) in the fold; inner margin whitish, mostly white at base; three dark lines in apical fringe (rarely four). Fore and middle legs blackish fuscous displayed; femora white, spotted; tips of tibiæ white; tarsi annulate; hind legs whitish, the joints annulate with darker. There are two broods, the moths flying in May and in August.

Moth in May. Larva pale green, in a pale orange blotch on the upper side of leaves of *Kalmia angustifolia*; in the autumn.

Connecticut; Pennsylvania.

3. **P. preciosella** Dietz. Dark bronzy-brown; spots violet-silver, the first dorsal joining the second costal spot, and the fourth dorsal minute but normally joining the fifth costal. 8 mm.

May. Larva on swamp huckleberry. (*V. corymbosum*) in autumn.

Pennsylvania; Connecticut.

4. **P. anglicella** Stainton. Dark gray, the inner margin not noticeably pale, the third line in fringe ending abruptly at the lower of the two white rays. 10 mm. (*fragariæ* Stainton.)

The larva forms a slender, conical roll of the edge of a leaf; on thorn and strawberry.

Europe; New England.

P. innotata Walsingham was not recognizably described, nor associated with a definite food-plant or locality.

United States.

P. trepidella Clemens. Palpi annulated with dark brown near tip.

This species is unknown to me.

Pennsylvania.

5. **P. cratægifoliella** Clemens. Head intermixed dark brown and gray; antennæ faintly annulate with whitish. Fore wings dark brown with a purplish hue, dusted heavily with whitish along inner margin; a dark brown streak in base of fold, and a blotch near middle which almost reaches the inner margin. Whitish costal streaks distinct near apex, the last pair enclosing the dark apex. Fringe with two dark streaks and with white tips. 8 mm.

The larva is a miner on thorn; it is greenish white with reddish brown dorsum and brown head. It pupates under the folded edge of a leaf.

The moth flies in may.

Pennsylvania; District of Columbia.

6. **P. dubitella** Dietz. Inner margin whitish, contrasting with ground; with the blackish plical spots, and two or three smaller ones on inner margin. 10 mm.

The larva forms a tract-mine on an undetermined shrub.

Pennsylvania.

7. **P. conspicuella** Dietz. Inner margin white on basal two-fifths only. Ground otherwise rather even. Striæ white, contrasting; about eight striæ on costa and five or more on inner margin, the outermost ones crossing fringe and cutting off the line in fringe, as in *anglicella*, but distinctly above the apex. Occipital tuft pale. 8 mm.

Caterpillar on black birch.

Pennsylvania.

8. **P. arbitrella** Dietz. No contrasts; costal striæ rather distinct, dorsal ones obsolete; a white discal bar. 8 mm.

Larva on Vaccinium.

Pennsylvania.

9. **P. melanotella** Dietz. Brown, with about nine equally strong, white streaks on costa; two white spots on fold, on a blackish ground; basal half of inner margin pale. 7 mm.

Larva on Cratægus.

Pennsylvania.

10. **P. geminatella** Packard. Fore wing dark brown and powdery gray, with obscure costal striæ and very obscure plical spots. 8 mm. (*prunivorella* Chambers ?)

Larva in a tentiform mine on apple and quince.

Distribution general.

11. **P. quadripunctella** Clemens. Face fuscous; tuft dark brown; fore wing with inner margin contrastingly whitish. 8 mm.
Larva on apple and chokecherry.
Eastern States to Kansas.
12. **P. vicinella** Dietz. Dark brown with a purplish tint, with dark and obscure markings. 7 mm.
Larva on yellow birch.
Pennsylvania.
13. **P. sorbivorella** Dietz. Grayish brown; occiput and thorax creamy white; markings mostly weak; plical spots black, contracting; a white discal bar. 10 mm. (*strobivorella* Dietz, misprint.)
Larva in a cone like Gracilaria, on mountain ash.
Pennsylvania.
14. **P. arbutifoliella** Dietz. Gray with brown costa; inner margin mostly white, with triangular black spots in fold. Head and thorax white. 9 mm.
Larva on *Pyrus arbutifolia* (chokeberry).
Pennsylvania.
15. **P. obliterella** Dietz. Purple-brown; fourth and fifth striæ widely separate; inner third of wing half white and half black. Head and thorax with much white. 8 mm.
Larva on *Betula nigra*.
Pennsylvania.
16. **P. inusitatumella** Chambers. Ground color uniform; three entire lines in fringe; moth similar to *prunivorella*, but smaller, with more distinct striæ, and no semierect scales on inner margin. 7½–8 mm.
Larva in an upper-side mine on *Cratægus tomentosus* and *C. mollis*, forming a nearly circular, whitish blotch with scattered frass, later made tentiform. Cocoon yellowish brown, spun on upper side of mine, outside.
Kentucky; Ohio.
P. trepidella and **festinella** Clemens are unknown to me; for *"Ornix" quercifoliella* Chambers and *boreasella* Clemens see Acrocercops.

2. *GRACILARIA* Haworth

(With *Coriscium* Zeller; *Euspilapteryx* Stephens, etc.)

Similar to Ornix; head smooth; scape sometimes with the rudiment of an eye-cap; palpi smooth, rough, or with a triangular tuft on second segment. Fore wing with all veins (fig. 115) or with one dorsal vein lost; R_1 arising close to base, easily mistaken for Sc, which is inconspicuous. Hind wing lanceolate or linear; venation weak and somewhat variable; typically with the tip of R_1 free as in Parornix.

The moth rests with head raised, and the two rough-scaled anterior pairs of legs displayed. Larva, after an early stage, cylindrical; at first forming a blotch-mine, later rolling a leaf into a conical nest. A few species are miners till mature.

The species of this genus are difficult to identify without knowledge of the food plants, as they are closely similar and often highly variable. The key will be a partial guide only.

Key to the species

1. Fore wing with a subtriangular, or larger, irregular, golden patch, normally contrasting with the darker ground; well-defined, at least on its basal side, and extending a third way across the wing, or more.
2. Upper part, at least, of face, and palpi dark. . 19. *purpuriella*, 20. *stigmatella*.
2. Upper part of face and palpi not dark.

3. Palpus with bands broad and fuscous, the ground more or less dusted with fuscous so that about half the total scales are dark; patch normally diffuse; ground of wing predominantly golden.....21. *negundella.*
3. Palpus white or partly yellow with less than half of the third segment contrasting black, and sometimes a narrow black ring on the second; rarely dark, in which case the fore wing also is dark.
4. Base on inner margin concolorous, the whole ground dark purplish, always with two well-marked golden spots.
5. Costa solid dark brown, not barred before apex; ground umber brown, with a violet-purple iridescence. Third segment of palpus with more black.
6. Brilliant royal purple; antenna pale; spots normally separated by half their width, the first crescentic and the second long and horizontal .....11. *burgessiella*
6. Smaller; blackish with slight purple iridescence and blackish antenna; the spots smaller and quadrate.....12. *cornusella.*
5. Costa beyond outer spot with three paler bars; ground and antenna yellow-brown, with brilliant crimson-purple iridescence; palpus with a small black spot near apex of third segment; spots large and nearly in contact, the first triangular.....13. *bimaculatella.*
5. Costa heavily and dorsum perceptibly barred toward apex; fuscous without purple iridescence. Half of third segment of palpus black. Spots small .....14. *Species A.*
4. Fore wing dark purplish, with base of inner margin contrastingly golden.
5. Palpi strongly yellowish, markings usually suffused, the outer spot often nearly obliterated.....23. *ostryœella.*
5. Palpi white, markings clean-cut.....15. *vacciniella.*
6. First spot large and triangular, and second one nearly in contact with it, or with the spots fused into a large, irregular patch. 16. *belfrageella.*
4. Fore wing dark purplish, with *middle* of base contrastingly golden; costal patch large and irregular.....25. *blandella,* 26. *juglandivorella.*
4. Fore wing crimson, the base of the inner margin more or less contrastingly paler.
5. A single, narrow, triangular, costal, golden patch, ending about at middle of costa.
6. Head and thorax reddish bronze.....27. *glutinella.*
6. Head and thorax light golden yellow.....18. *packardella.*
5. A large, irregular patch extending well toward apex, often diffuse except at base; or with two patches, the outer one suffused.
6. Vertex light golden, much paler than the ground of the wings; or golden areas suffused with brown.....23. *ostryœella.*
6. Vertex concolorous.
7. Thorax wholly golden; head predominantly golden. 24. *superbifrontella.*
7. Tegulæ dark, vertex more extensively dark.
8. Vertex and tegulæ rusty, with crimson iridescence. 24. *alchimiella.*
8. Vertex and tegulæ duller grayish purple; patch diffuse. 22. *azaleœ.*
5. Two well-separated and sharply defined patches.....17. *coroniella.*

Brown with numerous silver spots.....33. *serotinella.*
No golden area with sharply defined, oblique, basal boundary, on costa of fore wing.

2. Palpus with a small, triangular tuft on second segment.
   3. Ground all pale luteous and white, with very fine, black scale-tips. 31. *paradoxa.*
   3. Ground darker, with considerable brown or gray.
      4. Fore and middle tibiæ and under side of wings red-brown, tarsi whitish. 32. *quercinigrella.*
      4. Fore and middle legs powdery gray, with narrow white bands; underside gray.
         5. Ground dominantly white, with complete, blackish fasciæ; scales dark-tipped ..... 29. *cuculipennella.*
         5. White ground reduced to scattered spots, the fore wing almost wholly powdery gray and brown; fasciæ broken or obscure; scales white-tipped ..... 30. *fraxinella.*
2. Palpus smoothly scaled or nearly so.
   3. Reddish, with costal third suffused with yellow.
      4. Darker ground tan color ..... 9. *flavella.*
      4. Darker ground suffused with crimson.
         5. Larger; darker; costal edge with two larger dark dots, hind tarsi contrastingly darkened at tips of joints ..... 4. *sassafrasella.*
         5. Smaller; paler; several black points on costa; hind tarsi evenly silver gray ..... 10. *violacella.*
   3. Reddish, with costal edge very narrowly, or not at all, yellow. 6. *elongella.*
   3. Not reddish; gray or brown.
      4. Middle half of costal edge narrowly pale with dark dots.
         5. Pale edge sharply defined below; ground darker and richer brown. 2. *aceriella,* 3. *juglandiella.*
         5. Pale edge shading into the fuscous ground ..... 5. *rhoifoliella.*
         5. Fuscous gray, more or less violet-iridescent, the costal third faintly paler and costal edge striate at middle ..... 8. *minimella.*
      4. With traces of the two golden triangles; costal edge with dark dots 23. *ostryæella.*
      4. Costal edge concolorous, or nearly so.
         5. Dark brown, spotted with yellow-brown.
            6. Spots bright ochre and conspicuous, two on costa and two or three on fold ..... 7. *flavimaculella.*
            6. Spots fine, irregular, dull, and scattered ..... 6. *elongella.*
         5. Dark brown, powdered on a yellow ground, less heavily on costa. 6. *elongella.*
         5. Dark brown, powdered on a yellow ground; base darker. 28. *atomosella.*
         5. Dusted with blackish on a white ground, more or less heavily. 6. *elongella.*
         5. Blackish without noticeable markings ..... 1. *strictella.*

Synopsis by foods

Willow and poplar (moths with a single golden triangle):
Light red ..... 20. *stigmatella.*
Dark purple ..... 19. *purpuriella.*

Myrica:
Rusty, with yellower costa ..... 9. *flavella.*

Walnut:
A large, golden, costal patch ..... 25. *blandella,* 26. *juglandivorella.*
A series of yellow costal points ..... 3. *juglandiella.*

Ironwood (Carpinus and Ostrya):
Markings strongly variable.....23. *ostryæella.*
Birch:
Two costal patches; ground yellow and crimson.....17. *coroniella.*
Alder:
More or less distinct costal triangles.....27. *glutinella.*
No costal triangles.....6. *elongella.*
Oak:
Powdery gray .....32. *quercinigrella.*
Crimson, with large golden patch.....24. *alchimiella.*
Sassafras:
Dark crimson, with costal yellow shade bearing two dark dots..4. *sassafrasella.*
Witchazel:
Crimson, with large patch and golden thorax.....24. *superbifrontella.*
Apple:
Powdery gray .....30. *fraxinella.*
Cherry:
Black and silver.....33. *serotinella.*
Desmodium:
Crimson, with yellow costal shade and minute dots.....10. *violacella.*
Sumach:
Fuscous, with pale costa and dark points.....5. *rhoifoliella.*
Maple:
Suffused, with golden costal patch often diffuse (on *A. Negundo* only).
21. *negundella.*
Purple; two large triangles.....13. *bimaculatella.*
Crimson; one large triangle.....18. *packardella.*
Purple; four small spots.....14. *Species A.*
Deep brown; a series of costal points.....2. *aceriella.*
Cornus (all species purple with two spots):
Dorsal margin golden.....16. *belfrageella.*
Spots approximate; first one crescentic.....11. *burgessiella.*
Spots distant; first one quadrangular.....12. *cornusella.*
Azalea:
Light crimson and golden.....22. *azaleæ.*
Vaccinium:
Two small patches.....15. *vacciniella.*
Privet:
Gray and white.....29. *cuculipennella.*
Ash:
Powdery gray .....30. *fraxinella.*
Unknown:
1. *strictella*, 7. *flavimaculella*, 8. *minimella*, 28. *atomosella*, and 31. *paradoxa.*

I. Palpus smooth or nearly so (Gracilaria).

1. **G. strictella** Walker. Fore wings dark gray; with diffuse, blackish patches, and about five inconspicuous black dots, two of them costal. 18 mm. (*adaptella* Walker.)

This species is unknown to me; Ely associates it with *G. alnivorella* Chambers. This type was caught west of Hudson Bay.

2. **G. aceriella** Chambers. Similar to *G. juglandiella*, but slightly smaller; tip of palpus more distinctly white; fringe divided by two white lines.

This species was apparently discovered at Amherst, Massachusetts.

It is unknown to me. It was bred from maple.

3. **G. juglandiella** Chambers. Deep purple-brown. Face whitish below; palpus pale, with a narrow black terminal ring on second segment, and a narrow basal, and very broad subapical, ring on third. Fore wing obscurely striate with blackish along inner margin; middle half of costa cream-white, cut into about eight, squarish spots by black bars. Apex and fringe with more or less distinctly pale-tipped scales. 9 mm. (*juglandisnigracella* Chambers.)

Moth in September. Larva in August on walnut, at first in a short, linear mine, which is later converted into a blotch. Later folding down the edge of a leaflet and feeding outside. Pupation in the nest.

South Ohio; Kentucky; Missouri (?).

4. **G. sassafrasella** Chambers. Ochre yellow; the dorsal two-thirds of the wing heavily suffused with deep, dull rose. Head and thorax more brownish; antennæ black-annulate except at base. Fore wing with somewhat diffuse, blackish dots at middle and just below apex, and some scattered black scales. Apex brown, with three blackish lines in fringe. 12 mm.

July. Larva first forms a serpentine mine on sassafras, which is later converted into a tentiform one. Then it forms a clumsy case by rolling down the tip of a leaf, usually a young leaf. The pupa is formed in a yellow cocoon on a leaf. The larva is slender, lemon yellow, and with a light brown head. The larva occurs in June.

Connecticut to Missouri. New York; Ithaca.

5. **G. rhoifoliella** Chambers. Fuscous. Front white; inner side of palpus white with blackish tips to second and terminal joints. Fore wing darker toward apex and base of costa, with purple iridescence (much duller than *sassafrasella*), costa with basal and apical sixths wholly blackish, the rest shaded with cream-color and cut with dark striæ, which are more numerous than in *juglandiella*, and thinner, with a single heavy one at the middle. Inconspicuous coarser striæ on inner margin, and sometimes on fold. Apical fringe with a couple of pale bars. 12 mm.

Larva with the same habits as that of *G. sassafrasella*, feeding on *Rhus toxicodendron* and *R. copallina*. Moth in July and August.

New Jersey to Missouri and Minnesota. New York: East Aurora, Ithaca.

6. **G. elongella** Linnæus. An extremely variable species, some of its forms determinable only by breeding from its food, alder. Typically crimson, unmarked with red-brown fore and middle tibiæ, and dirty whitish hind tibiæ tinted with brownish. Forms occur with narrow, contrasting, yellow costal edge (**inconstans** Stainton), or with more extensive yellow costal markings, which are sometimes extended into a vague likeness of the costal triangle of the normal group of Gracilaria; and there may be also similar markings on the inner margin. In var. **punctella** (*signipennella* Hübner) there are a couple of fuscous dots, and the middle tibiæ are blackish. Form **inconstans** and most of the mottled forms have white hind tarsi; var. **signipennis** has the white tarsi, and three blackish dots on the fold; and the immaculate forms also occur with white tarsi. For American forms (which some consider a distinct species, calling it *alnivorella* Chambers) **alnicolella** Chambers represents the uniform red-brown form; var. **sanguinella** Beutenmuller is the red and yellow one; **pulchella** Clemens, the brick red one; **fuscoochrella** Beutenmuller is suffused generally with fuscous; **nigristrigella** and **ruptostrigella** Beutenmuller are mottled, brown, yellow, and black varieties, differing in slight details. **Alnivorella** Chambers is the pepper-and-salt form and is the oldest American name; and **shastaëlla** Beutenmuller is the greenish white form with sparser black dotting. All the forms and a variety of intermediates have been bred from alder in this country or Europe, and seem to represent a single species. Many of the forms were described from definite localities, but any are likely to occur anywhere in our area. The larva makes the usual cone on alder.

The species is evidently widespread but appears common only northward. New York: Wilmington, Mt. Whiteface, McLean.

7. **G. flavimaculella** Ely. Brown; face overlaid, and vertex more or less scaled, with pale yellow-brown; antennæ annulate with dark brown and yellow-brown; palpi straw color, the second segment heavily shaded with brown outwardly, and the third brown except at base and apex. Fore wings with rather diffuse markings of pale yellow-brown, especially along the fold, dorsal margin, and costal margin beyond the middle, forming two conspicuous yellow splashes on costa. Front and middle tibiæ dark brown; tarsi straw color, annulate with dark brown. 10 mm.

Moth from July to September. Larva unknown.

Southern Connecticut.

8. **G. minimella** Ely. Fore and hind wings each with a dorsal vein lost. Fore wings dark mouse-gray with perceptibly paler costal third, cut by very faint costal striations, especially on middle half of costa. Palpus on inner side white, with a broad blackish band on third segment; second segment on outer side with a blackish tip, third mostly blackish with a white tip. Unlike *rhoifoliella* in the lack of a whitish costa and different palpi. 9–9½ mm.

July and August. Larva unknown.

Southern Connecticut.

9. **G. flavella** Ely. Yellowish tan; face and palpi pale yellowish; vertex with purplish iridescence. Costa bordered with bright straw color; hind wings and fringes yellow-gray, the apical fringe straw-color, intermixed with tan. Legs as usual. 10 mm.

July. Larva on *Myrica cerifera* in June. Mine at first linear, then a small blotch (up to 2 by 4 mm.). Cone formed by rolling the tip of a leaf downward.

Southern Connecticut.

10. **G. violacella** Clemens. Head and antennæ purplish brown; face white; palpi pale, with second and third segments each heavily dark-tipped. Fore wing with costal third light yellow except at apex, the rest light brown; a dozen dark points on costal edge. All the dark portions heavily shot with violet. 8 mm. (*desmodifoliella* Clemens). There is also a darker phase with the yellow costa extending only two-thirds way to the apex, and the third tarsi shaded with gray.

The larva feeds on Desmodium, at first in a small linear mine, then in a tentiform one; later rolling down the edge of a leaf from the tip. The moth emerges in August. It is generally distributed.

The remaining species of this group all show more or less clearly a triangular golden patch on the costa, before the middle, or a larger and irregular patch.

11. **G. burgessiella** Zeller. Fore and middle tibiæ dull black, contrasting with the whitish tarsi and whitish hind legs, as in all this series. Face silver white to level of antennæ, vertex brown. Thorax brown; palpi white with a short black tip. Fore wing umber brown, with purple iridescence, the more basal golden spot comma-shaped or semicircular, with the straight or concave side outward; marked with dark dots on costa. Postmedial spot nearly quadrate, twice as long as wide. No subterminal bars on costa. Fringe fuscous with faint lines in apex. 11–14 mm.

Moth at the end of July and in August; apparently rare. Caterpillar on Cornus, in July; at first in a linear mine, then a blotch, then a cone formed by rolling the tip of the leaf downward.

Cocoon formed outside the mine. This name has been frequently applied to a variety of dark purple Gracilarias without a pale base to the inner margin, but seems unquestionably to belong to the species described above.

Massachusetts; Connecticut. New York: Ithaca.

12. **G cornusella** Ely. Similar to *G. burgessiella*, smaller; ground blackish, with faint iridescence; first golden spot normally quadrate, extending to fold, not large; second spot minute, separated from the first by twice its diameter. No subapical costal dots. Fringe and apex immaculate dark brown. Antennæ darker than *G. burgessiella*. 10 mm. (*burgessiella* of authors).

The caterpillar when young forms the mine usual in the genus; then lives in a cylindrical nest made by rolling down one side of a leaf. The cocoon is spun in the roll. The moth has been obtained in April and in August.

Connecticut to Missouri. New York: Ithaca.

13. **G. bimaculatella** Ely. Light brown with crimson iridescence, the antennæ yellow-brown. Head and thorax dark brown, darker than the wings; the face silvery. Palpi with a little black at the tip only. Fore wing with first golden spot large, triangular, practically reaching inner margin; and second nearly, or quite, in contact with it, less perfectly triangular; or roughly semicircular, with a few, obscure, dark spots between it and the apex. Apical fringe yellow-gray with darker lines. 11 mm. (*burgessiella* of collections; *amphidelta* Meyrick?).

The caterpillar lives in a cone on red and soft maple. The species seems fairly common but is usually taken for something else.

Ontario to Connecticut; New York; Missouri. New York: Ithaca.

14. **G. species A.** Similar, much smaller; first golden spot narrow, barely reaching fold, crescentic, followed by four successively smaller, golden dots on costa, the last practically apical, and each defined on the outer side with a black line. Fringe mostly blackish, with the usual darker lines. 7–8 mm.

Moth in September and October. Larva on maple.

New York; Missouri.

15. **G. vacciniella** Ely. Dark purplish, including vertex and upper part of face; palpi with brown tips; antennæ annulate, as usual in the genus; fore wing with two spots, the first triangular, with its basal margin rounded and its outer margin perpendicular, and reaching to fold; outer spot separated from the first by about its width. Base of inner margin yellow. Fringe smoky gray, dark at apex and with obscure lines in it. 11 mm.

The moth flies at the end of July. The larva feeds on Vaccinium.

Pennsylvania.

G. anthobaphes Meyrick is similar, but with a small additional golden spot at anal angle. It occurs at Lake Muskoka, Ontario, in July and August.

16. **G. belfrageella** Chambers. Purple. Face and palpi white; a dark dot on tip of second segment of palpi; costal triangle typically pale golden, truncated on the fold, and extended as a wide band along the costa to the beginning of the fringe; base of inner margin dark. 11 mm.

Rarely the costal patch is cut into two separate spots.

The larva feeds on *Cornus asperifolia*, at first in a linear winding tract on the under side of a leaf, then in a blotch, which is crinkled later; finally in the usual cone. It pupates in a fold of the leaf. Other specimens, which roll the whole leaf in a long cylinder, appear to make the same moth, but more often with separate spots. This name is often misapplied to one or another of the maple species.

Southern Ohio; Texas.

17. **G. coroniella** Clemens. Dark yellowish, overlaid with crimson; head dark yellowish; palpi with third segment dark on outer side. Fore wing with a triangular patch at middle extending only to fold, and not running out on costa; a couple of dark points on costa within it, and a small pale spot on costa beyond it; apex pale; fringe yellowish, tipped with black. 10 mm.

Larva on birch.

Illinois.

18. **G. packardella** Chambers. Light orange with strong crimson iridescence; strongly variable in brilliance; antennæ ringed with golden and fuscous as usual in the group; occiput golden, face silver white; fore wing with a nearly equilateral golden triangle, reaching nearly to the inner margin; and inner margin at base shaded with pale golden. 12 mm. (*inornatella* Chambers, in part; *elegantella* Frey.)

Larva on sugar maple. *G. packardella* has been confused with *G. alchimiella*, which has an entirely differently shaped patch.

Generally distributed. New York: Ithaca.

19. **G. purpuriella** Chambers. Dull grayish brown with purple iridescence, the face typically white below, but often only slightly paler; labial palpi blackish on outer side, except at extreme apex, dirty white within. Fore wing with base of inner margin concolorous, the triangle white, often scaled with fuscous, and variable in size, but normally narrow with concave sides, ending in a point near or above the fold; costa outwardly with faint pale and dark striæ. Apical fringe gray, barred with black. Tarsi with more dark scaling than usual. 12 mm.

This form is general in distribution; and is common in August, and from October to April. The caterpillar feeds on willow and poplar, rolling the leaf down from the tip, and sometimes using a whole leaf. The pupa is usually formed in the roll, rarely in a web outside. Ely considers this form conspecific with *G. stigmella*, but they appear distinct to me.

New York: Ithaca.

20. **G. stigmatella** Fabricius. Closely similar, but with paler reddish ground. Face on the average more extensively pale; triangle with very little dark scaling, and relatively larger, not pointed on the fold (*upupœpennella*).

Larva on willow. Moth in July.

Wales, Maine; Framingham, Massachusetts; Cincinnati, Ohio; New Brighton, Pennsylvania; Europe. Possibly introduced in America.

21. **G. negundella** Chambers. Light tawny brown, suffused with crimson and greenish; the costa patch not at all contrasting in light specimens. Palpi dirty yellowish white, with tips of joints blackish; antennæ brown, obscurely annulate. Head and thorax dull, and rather greenish on the whole; face pale below. Fore wing with costal patch large and irregular, extending nearly to apex, as in typical *belfrageella*; apex with obscure yellow spots; fringe with three blackish stripes. 13 mm.

The palest specimens show brownish spots in the ground, especially toward the apex. Eastern specimens are darker than the types (from Colorado) and show black dusting on the palpi, and the basal half of the costal patch has some black edging. 13 mm.

July and August; October to early spring. Caterpillar at first in a narrow, linear mine on under side; then crossing to upper side; then forming a large, whitish blotch; and finally, the usual cone: on *Acer negundo*.

Ohio and west (probably also eastward where the food occurs,)

22. **G. azaleæ** Busck. Head, thorax, and base of fore wing, except on inner margin, dark purple; costal half of fore wing golden almost to apex, dorsal margin tawny with crimson iridescence; the boundary usually diffuse. 10 mm.

This species is a green-house pest on evergreen azaleas, and has apparently been introduced from Japan via Holland. It has been confused with *zachrysa* Meyrick, but appears distinct. The latter is an Indian species feeding on apple.

Massachusetts. New York: Rochester, Yonkers.

23. **G. ostryæella** Chambers. *Autumn form:* Antennæ grayish, annulate with dark brown; palpi yellowish white, the second and third joints with broad black apical bands; maxillary palpi similar. Face golden below, more or less scaled with brown and sometimes with a brown cross-line. Fore wing pinkish brown, speckled with patches of blackish scales, with a more or less distinct elongate patch near anal angle, leaving a few golden scales on the margin. Pale costal triangle dark-margined and separated from the patch beyond the triangle; golden, suffused with dark except at its boundaries on costa and inner margin; outer spot more or less suffused. 10 mm.

The larva feeds on Ostrya, in a linear, whitish mine on the upper side of a leaf; then in a whitish, digitate blotch over a vein, which it eats out transparent before

deserting it, leaving a network of brown veins. Finally the larva forms the usual cone.

Southern Ohio; Kentucky.

Supposed *summer form:* Antennæ ochreous, broadly annulate with dark; darker toward the apex; palpi yellowish white; third segment annulate with dark just before the apex; maxillary palpi yellowish white. Face, head, and thorax pale golden; vertex bronzy; fore wing suffused with purplish bronze; a pale golden patch at base; triangle pale golden, large, truncated on fold, extended out on costa, with very slight, dark points on the costal edge. Hind wing fuscous with reddish fringe. Hind tibiæ and tarsi mostly yellowish white. 10 mm.

The larva lives in a mine on the *under* side of Carpinus and Ostrya, the blotch when finished becoming similar to that of the autumn form, as the parenchyma is eaten out.

24. **G. superbifrontella** Clemens. Rose-violet, iridescent on a base of tawny yellow; palpi yellow with brownish tip; antennæ dull yellow, vertex shaded with reddish violet; thorax wholly golden. Hind wing very dark. Fore wing with large, irregular, costal patch, and base of inner margin suffused with golden. 11 mm. (*alchimiella* of authors).

June to August. Larva in a conical roll on Hamamelis; pale green with pale brown cervical shield.

Distribution general. New York: Crosby (Yates County); Ithaca.

G. alchimiella Scopoli, a European oak species, has been reported from Essex County, New Jersey. The golden spot on the inner margin is more sharply defined; the head is lighter crimson rose; and the tegulæ and a spot on the disc of the thorax are tawny. *Packardella* has sometimes been determined as this species.

25. **G. blandella** Clemens. Dark purple; face yellowish; vertex with purple-tipped scales; antennæ strongly annulate; palpi yellowish with a brown spot on outer side of second joint, and on tip of third. Fore wing with usual patch very large and irregular; the wing strongly golden-iridescent at base, sometimes forming a central, diffuse, basal spot. Fringe dark with a pale line in the middle; hind wings pale fuscous.

This species is unknown to me.

Virginia.

26. **G. juglandivorella** Chambers. Closely similar to *G. blandella;* joints of maxillary palpi purple-tipped; vertex largely purple; thorax with three lemon-yellow stripes; yellow patch perhaps less extensive. 8 mm.

Larva on black walnut; at first in a linear mine, reaching an inch long, then under a series of small flaps, eating the parenchyma, and pupating under the last flap. The larva changes to the cylindrical form on leaving the mine.

I have not seen this form. The preceding species and this probably identical; and are so considered by Ely.

Virginia.

27. **G. glutinella** Ely. *Summer form.* Reddish bronze, face yellow; palpi straw color, shaded with dark brown just before the apex, darker outwardly; antennæ annulate. Fore and middle femora and tibiæ reddish bronze; hind tibiæ dark-shaded at apex. Fore wing with some straw-yellow scales, especially toward apex of costa; triangle shining golden, truncated shortly on fold; no outer spot. Fringe gray, with two dark lines around the apex. 12–13 mm.

July–August. Larva in a roll on *Alnus glutinosa*, in July.

Southern Connecticut.

Supposed *winter form:* Ground dark purplish, intermixed with straw-colored scales; face pale yellowish, edged with brown on sides; vertex darker and more straw colored; palpi shaded throughout with dark purple, third segment with a heavy black ring at the tip; maxillary palpi also shaded with purple. Antennæ

darker. Fore wing with costal triangle pale straw yellow, almost obliterated with dark purple suffusion; fringe gray, almost concolorous at apex with two dark lines. 13 mm.

The moth is distinguished from *coroniella* by the darker coloring. It flies in September; doubtless wintering, and reappearing in April.

The larva occurs on alder in August, at first on the under side of a leaf, in a linear mine; which ends in a small blotch, which is usually near the margin; then later in one or two shelters formed by turning down the edge of a leaf; and finally, in a cone at the apex of the leaf. The cocoon is formed outside the mine.

28. **G. atomosella** Zeller. Thorax and fore wing heavily dusted and shaded with blackish, on a pale ochreous ground; fore wing with pale striæ toward costa and inner margin; one of these, before the middle of the costa, being the most distinct marking, and extending obliquely out almost to the inner margin. Base darker. Head white, *somewhat tufted behind.* Palpi black with two white rings on second joint, and base of third joint white. Maxillary palpi with white dots. 14 mm. (*atmosella* Ely — misprint).

This species is unknown to me.

Texas; "Atlantic States" (Ely).

II. *Palpus with a triangular tuft on under side of second segment* (Coriscium).

29. **G. cuculipennella** Hübner. White, with oblique fasciæ formed of black-barred scales, and mixed with brown scales, which concentrate at the edges of the fasciæ, forming brown lines; base powdery gray; basal half of wing with two fasciæ, extending obliquely outward, the first heaviest on inner margin, the second stronger, and usually ending just above the inner margin; a similar medial fascia. Outer half of wing with diffuse spots and short vertical fasciæ; fringe with dark-tipped scales, gathering in three or four lines. Head, thorax, palpi, and tibiæ powdery gray, barred with white, the tarsi hardly lighter. Inner side of palpi white. 10–14 mm.

Larva on privet.

Europe.

American records probably apply to *fraxinella*, which may be only a race of this species.

30. **G. fraxinella** Ely. Similar. Powdery gray areas more diffuse, the scales mostly finely white-tipped; usually with the fasciæ broken up, and obscure; rarely with fasciæ contrasting and black, but broken into spots. Fringes more suffused with gray than in *G. cuculipennella;* head and thorax darker. The white ground color is reduced to a large number of spots, many of them rounded. 12–14 mm.

Moth in July and May, the latter doubtless specimens which had emerged the preceding fall. Caterpillar on ash and apple, in the usual cone, in June. This may be a synonym of *G. paradoxa* Frey and Boll.

Connecticut. New York: Ithaca.

31. **G. paradoxa** Frey and Boll. White, heavily and rather evenly dusted with finely black-tipped, clay-colored scales, leaving a white antemedian fascia across the wing, and obscure, alternately light and dark mottlings along the margins outwardly. Head rather more lightly dusted, and palpi more heavily, except the tip of the second segment and base of the third. 12–15 mm. (*Parectopa.*)

Moth in April and early May. Larva unknown.

Boston, Massachusetts; New Brighton, Pennsylvania.

32. **G. quercinigrella** Ely. Similar to *G. fraxinella*, powdery gray. Palpi only lightly dusted; fore and middle tibiæ red-brown; tarsi white, ringed with red-brown; hind legs yellowish; the femora and coxæ shaded with red-brown. Fore wing with markings diffuse; base much paler below fold than above; antemedial fascia oblique outward, pale gray; outer part of wing with obscure, con-

cave fasciæ. Under side red-brown. Hind wing pale-gray, partly red-brow below. 10 mm.

The moth flies in September. The cone is formed by bending down and unde a lobe of the food leaf (red oak, etc.). The leaf is eaten through in a series o small holes where the edge of the flap is attached. The larva is whitish wit brownish incisures, and occurs early in July. Apparently there is only one brood

Southern Connecticut.

33. **G. serotinella** Ely. Palpi with a very small pointed tuft. Ground black brown; basal half of third segment of palpi yellow; tarsi pale. Fore wing wit numerous, greenish-silvery spots, irregularly scattered and more or less fused especially so as to form an outwardly oblique sub-basal fascia and a V-shape antemedial spot resting on costa (enclosing a spot of the ground color). Apica fringe cut with four yellow bars. Dorsal fringe and hind wing mouse gray. 15 mm

The moth occurs in July and August. The larva forms the tip of a leaf o *Prunus serotina* into a cone. The cocoon is boat shaped, flat on top, and is spu in a partly folded leaf.

Dublin, New Hampshire; East River, Connecticut. New York: Ithaca.

3. *ACROCERCOPS* Wallengren

(*Gracilaria, Coriscium,* in part)

Similar to Gracilaria; hind tibiæ of the northeastern species with a couple of rows of stiff straight bristles above, about a quarter as long as the lengt of the tibiæ, or somewhat less. Antennæ fully as long as the fore wings, palp typically with a slight tuft on second segment, large and triangular in *A. quin questrigella*; maxillary palpi minute in some exotic species. Wings about a in Gracilaria; in the fore wing with all veins present, or one dorsal (apparently **Cu**) lost, as in *A. onosmodiella.* Hind wing often a little more reduced than i Gracilaria, R_1 regularly being lost, and M_3 also in *A. strigifinitella.* Resting posi tion with the fore and middle legs displayed as usual, but sometimes with th head appressed to the object on which the moth is resting.

The caterpillar is of various types, but in all cases it feeds in the cylindrica stage (fig. 121). The transformation to the cylindrical stage is sometime gradual. The larvæ are usually blotch miners, the cocoon, typically, being forme in the mine. Our species belong to various groups of the genus, which is very large in the Orient.

Key to the species

1. Inner margin with two large, silvery patches.....7. *albinotella*
1. Inner margin with a slender silvery streak.
  2. Streak ending a fourth way out; ground color golden .....5. *onosmodiella*
  2. Streak ending halfway out.....8. *venustella*
  2. Streak reaching to anal angle.....6. *quinquestrigella*
1. Inner margin with silvery spots or fasciæ only.
  2. Four rounded, white spots on margins.....4. *boreasella*
  2. Extremely slender white fasciæ, alternating with heavier black ones.
    3. Costal and dorsal series at right angles to each other.....1. *strigifinitella*
    3. Stripes running across the wing, farther out on inner margin....3. *strigosa*
  2. Moderate white fasciæ and no black ones.
    3. Ground dull brown; six or seven fasciæ straight across the wing..3. *strigosa*
    3. First two dorsal fasciæ lying along the margin; four or five in all; ground shaded with luteous.....2. *astericola*

I. *Maxillary palpi very small, less than a fifth as long as labials; palpi smoothly scaled; spining on hind tibiæ moderate.* M_3 *of hind wing lost. Larva changing gradually from flat to cylindrical type* (Neurobathra *Ely*).

1. **A. strigifinitella** Clemens. Palpi yellowish white, barred with brown; head and antennæ dull brown; fore wings grayish brown, striate obliquely from both margins with fine white striæ, edged with black, alternating with heavier solid black ones. An apical ocellus. 8 mm. (*Dialectica* Walsingham; *Ornix quercifoliella, Gracilaria duodecimlinella* Chambers.)

The larva feeds on chestnut, chinquapin, oak, and beech. In the first two stages it is of the flat type, and makes a linear mine; the third stage larva is cylindrical, with an essentially normal head, but with rudimentary legs and the head flatter than it is later. It bores in a lateral vein. The fourth and later stages are of the normal cylindrical type, and bore in the midrib. If the supply of food in the midrib fails, the late larva forms a large, puffy blotch-mine, with scattered frass. There is no non-feeding stage. Pupation is outside the mine, in a white cocoon decorated with four separate masses of froth. The species breeds continuously all summer.

New York to Missouri. The species is in the Robinson collection, presumably from this State.

II. *Maxillary palpi a fourth as long as the labials, which have a more or less distinct triangular tuft on the second segment; larva (so far as known) changing abruptly to final stage; tibial bristles variable. Fore wing with traces, at least, of all dorsal veins* (Acrocercops).

2. **A. astericola** Frey and Boll. Luteous, more or less dusted with brown; head, with its appendages, white. Fore wing with a broad, oblique, more or less triangular, white fascia two-fifths way out, edged, especially inward, with black; not reaching inner margin; two others, half as wide, beyond it, which have a heavier black edging. Apex white, preceded with black and followed by a double bar in the fringe; the outer fasciæ reaching the inner edge of the membrane. A short antemedial costal fascia, and two on inner margin. 9 mm. (*Gracilaria, Parectopa.*)

May, August.

The larva forms a large, tentiform blotch mine on *Aster corymbosus* etc.; the pupa is outside the mine, in a firm cocoon.

Massachusetts to western Pennsylvania. New York: Ithaca.

3. **A. strigosa** Braun. Dull brown, with seven slender, parallel, outwardly oblique, white fasciæ across the wing, more or less edged with black, and somewhat broken. 10 mm.

The moth occurs in June. The larva is found on *Quercus prinus,* at first in a narrow white gallery, then in a large, whitish blotch, from which the parenchyma is gradually eaten out. The cocoon is dense and brownish, with the usual globules. The larva is full grown at the end of May.

Tryon, North Carolina; Powell County, Kentucky.

4. **A. (?) boreasella** Clemens. Fuscous, with nearly round, white, postmedial and subterminal spots on costa, and medial and subterminal ones on inner margin, the last extending into the fuscous fringe. 9 mm. (*Ornix* ? Clemens, *Gracilaria* ? of authors.)

Labrador.

5. **A. onosmodiella** Busck. Golden brown; head, thorax, and appendages for the most part silvery; antennæ dark with silver line; fore wing with markings heavily black-edged; a large, antemedial crescent on costa, followed by three triangles; two silver triangles on outer part of inner margin, alternating with two costal ones; base of inner margin and apex silver white. Palpi wholly white. 9 mm. (*pnosmodiella* Busck, *lapsus calami*).

July. The larva a blotch miner on Onosmodium, of the family Boraginaceæ. District of Columbia to California.

6. **A. quinquestrigella** Chambers. Palpi white, second segment with a large, triangular tuft, like that of Coriscium; two dark rings on the third. Fore wing fuscous brown; inner margin narrowly and evenly white, with some dark scales, running out at anal angle; with paired, whitish streaks running obliquely out from costa and from upper edge of the dorsal streak, the outermost ones in the base of the fringe, and meeting at a right angle over the apex; these streaks are slightly edged with darker brown, and have dark streaks between them. 5 mm. (*rhombiferellum* Frey and Boll).

Kentucky; Texas.

7. **A. albinotella** Chambers. Head, palpi, antennæ, and fore wing silvery white; antennæ annulate with brown; palpus with second joint tufted, brown-gray, with white tip. Fore wing shining, light olive brown; thorax with a silvery, central band continued as a band on the inner margin of the wing, gradually narrowing to the anal angle, and interrupted by projections of the brown area; three white, outwardly oblique, costal fasciæ, the first usually broken, and joining the white dorsal area; a white apical spot covering the costal fringe, and edged below with a black crescent; apical fringe brown, vaguely banded; dorsal fringe shaded with white. 9 mm.

Moth in April and June, and again in August. Larva in a large, tentiform mine on under side of leaves of oak; at first in a linear mine. (*Coriscium albinatella, albonotella* Chambers.)

New York to Maryland, Ohio, and Missouri. "New York" (Beutenmuller).

III. *Fore wing with one dorsal vein completely lost;* R_4 *and* R_5 *stalked* (Leucospilapteryx *Spuler*).

8. **A. venustella** Clemens. Head and eye-cap silvery white; palpus with two blackish spots; antennæ dark brownish. Fore wing dark, purplish ash gray, with a white streak along inner margin from base half way to apex; a small, white, antemedial, costal spot, and three somewhat convergent white streaks beyond, equidistant at costa, and extending obliquely outward. Apical spot white, with dark margin, and containing a black dot. Fringe mouse gray, mixed with white. 8 mm. (*eupatoriella* Chambers).

The moth occurs from late July to September. The larva makes several, successive tentiform blotch-mines on Eupatorium. Apparently the same species occurs on *Ambrosia artemisiæfolia* but I have seen only a rubbed specimen. Possibly it is *A. astericola*.

Cincinnati, Ohio, and District of Columbia to Pennsylvania, Kentucky, and Missouri.

4. *APOPHTHISIS* Braun

Similar to Acrocercops; antennæ rather shorter than fore wing, with a pecten; maxillary palpi rudimentary; bristles on hind tibia rudimentary, rather like stiff scales. Fore wing with R_1 weak, R_5 and M_1 stalked, forking over the apex; M_2 and M_3 absent; hind wing as in Acrocercops.

The resting position is about as in Ornix.

1. **A. pullata** Braun. Dirty white; scales fuscous-tipped; head and palpi gray, antennæ lightly annulate. Fore wing with darker streaks near base and beyond middle of fold; a faint, darker line in fringe. 5½–6 mm.

The moth has been taken late in July and in May. The larva is a miner in buckthorn, in July and October; the mine at first is obscure and linear, and later becomes a large blotch, 5–8 mm. wide. Pupation takes place outside the mine, in a flat, oval, yellow cocoon.

Cincinnati, Ohio.

5. *LEUCANTHIZA* Clemens

Front and vertex smooth, a small, loose tuft on occiput; antennæ as long as fore wings, basal joint small, not modified; palpi short, straight, drooping; maxillary palpi rudimentary; tongue short, apparently naked; hind tibiæ with long bristly hair (?). Fore wing lanceolate (fig. 118), with four traceable veins running to costa, R_1 being lost; two or three veins from cell to inner margin. Hind wing with R and M_1 closely parallel, but without forked veins.

Caterpillar of Gracilariid type, forming a large blotch-mine on upper side of a leaf. Cocoon of white silk, outside the mine. At rest the moth holds the antennæ extended laterally, as do other members of the family. This is an aberrant genus, which has not been fully studied, and may be misplaced in the keys. The short palpi may cause it to be sought among the Lyonetiidæ; and there may be a real kinship to Phyllocnistis.

Key to the species

Base of inner margin brown.....*amphicarpeæfoliella.*
Base of inner margin golden.....*dircella.*

1. **L. amphicarpeæfoliella** Clemens. Head lead color; antennæ golden brown, tips silvery white. Fore wings deep orange, shading to golden brown toward the apex; base deep brown, bordered by a strongly excurved, lead-gray line from costa to basal angle; a large, irregular, triangular, golden patch on middle of inner margin, extending up nearly to middle of wing; a golden streak at beginning of costal fringe, with two dots before it; fringe golden brown; hind wings gray. 6 mm.

May. Larva in an upper surface mine, on *Amphicarpa monoica;* green with brown dorsal, and darker ventral, spots, after the last molt becoming wholly green.

Connecticut; Maryland; Pennsylvania.

2. **L. dircella** Braun. Orange yellow; head golden with darker hairs behind; antennæ dark brown, tips silver white; thorax golden, dark brown in front. Fore wing with base dark brown, except toward inner margin; apical area dark brown; antemedial golden fasciæ straight. Base of inner margin orange; an oblique, curved golden streak from antemedial region below costa to middle of costa; a small, costal streak at beginning of fringe; a short, golden, dorsal streak margined toward base by an oblique line, dark brown scales; a longer oblique streak at anal angle, and a faint, golden, marginal line. Fringe and hind wing dark brown. Legs golden with dark brown tarsi. 5–6 mm.

July. Larva in late June and in September, in a large, sometimes digitate, upper-side blotch, on *Dirca palustris*; often social. Cocoon outside the mine.

Clermont County, Ohio.

6. *MARMARA* Clemens

(*Æsyle* Chambers; *Gracilaria,* in part)

Head smooth; antennæ with pecten scaly and suggesting an eye-cap, or normal; palpi moderate, smooth-scaled, ascending in life but usually porrect when dry; maxillary palpi moderate, porrect; tongue naked. Tibiæ smooth-scaled. Fore wing (fig. 117) with only five veins arising from the cell, three running to the costa and two to the inner margin, all free. Fringe as usual in the family. Hind wing linear-lanceolate, with fringe four times as wide as membrane; Sc and R obscure; a forked stem in middle of wing, free from **Rs; Cu** simple.

The larvæ are of the flattened type in all the feeding stages, becoming cylindrical just before pupation. They are extremely broad at the anterior end and lobed at the sides. They are leaf miners, or miners in the bast of twigs, usually forming a tract. The cocoon is spun outside the mine and is covered with more or less confluent masses of pearl-like, white bubbles. The genus is only definitely known from North America, but has been generally confused with Gracilaria. Besides the

species mentioned in this work, there is an undescribed species of the light group, on elm; and one of the dark group, on Hibiscus.

Key to the species

1. Dominantly pale.
   2. A large, basal, blackish patch on costa.....1. *fulgidella.*
   2. Some blackish scales near base of costa only.....2. *elotella.*
1. Dominantly dark.
   2. Second fascia erect, complete, as wide as the dark space before it..4. *fasciella.*
   2. Second fascia outwardly oblique, bent, and half as wide as the dark space before it, or broken.
      3. First fascia twice as wide on inner margin; the second offset its width at middle .....7. *serotinella.*
      3. First fascia even in width or broken.
         4. Brilliant, golden brown, with silver markings.....9. *auratella.*
         4. Dull fuscous brown, hardly shining.
            5. Ground powdery, the pale scale-bases showing; palpus with heavy band on third segment.....5. *opuntiella.*
            5. Ground even, palpi with third joint pale.
               6. Ground nearly black.
                  7. Fasciæ complete or nearly so.
                     8. Head silver white.....3. *salictella.*
                     8. Head tinged with yellow.....8. *apocynella.*
                  7. Fasciæ broadly interrupted.....6. *smilacisella,* (7) *pomonella.*
               6. Markings edged with black, on a lighter brown ground.
                  4. *quinquenotella.*

1. **M. fulgidella** Clemens. Head and antennæ yellowish white. Maxillary palpi dark. Fore wing silvery white with a dark brown blotch at base, not extending across the wing; a dark brown band rather below middle, sharply angulated just above the inner margin, and darkest along its outer edge; outer part with two broad, costal fasciæ confluent in the middle of the wing, with a white costal spot between them, and a white spot on inner margin opposite. Apex dark, with a white costal streak before it. Hind wing dark fuscous. 7½ mm.

Larva on *Quercus prinus;* with the habits of *serotinella.*

Pennsylvania.

2. **M. elotella** Busck. Paler than *M. fulgidella*; moth mostly white; antennæ yellow, darker toward the tip; palpi with black bars; tibiæ mostly white. Fore wing white, with yellow-brown bands edged outwardly with black; the first costal spot slight and tending to break up, the two outer fasciæ markedly separate, diverging in the dorsal fringe, and followed by an apical dot. Hind wing clay color.

Larva under bark of apple twigs, leaving a winding scar.

South Connecticut. There is a closely similar, possibly the same, species on elm in Virginia.

3. **M. salictella** Clemens. Antennæ grayish fuscous; head and palpi white; occiput (as in the following species) fuscous. Maxillary palpi dark; second joint of labials touched with fuscous. Fore wing dark gray-brown, with silvery-white markings; a fascia at basal third; and a somewhat oblique one at middle, slightly excurved and sometimes broken at middle; with two costal spots and one or more on inner margin beyond it; the outermost spot sometimes forming a bar across the apical fringe. Fringes paler, whitish at apex; hind wing grayish fuscous. 6 mm.

June, July.

The caterpillar forms a long, linear mine under the bark of willow twigs in the fall, which at that time is inconspicuous. In the spring it is revealed by the scarring of the bark over it. The larva in early spring is pale yellow; later developing

ransverse red stripes and two dark cervical spots. Pupation is outside the mine. Occasionally this species is injurious by girdling the twigs and small branches.

Connecticut to Virginia.

4. **M. fasciella** Chambers. Similar to *M. salictella;* ground lighter, and distinctly brown; each fascia black-edged on the inner side, the first two fasciæ equal, and as wide as the space between them; third fascia sometimes broken; second fascia straight; maxillary palpi pale. (*Æsyle* Chambers, *Acrocercops* of authors.)

Quinquenotella Chambers is generally considered an aberration of this species. In it the second fascia is broken into squarish costal and dorsal spots, the dorsal one lying farther out than the costal.

5. **M. opuntiella** Busck. Paler and more mottled than *salictella*; distinctly black-powdered on a whitish ground; first fascia obscure, second only nearly complete; palpus with a black band on third segment; maxillary palpus pale yellowish.

This species was described from Texas, but probably occurs as far north as the prickly pear, its food plant. The larva makes a long, irregular, winding mine under the epidermis of Opuntia.

6. **M. smilacisella** Chambers. Similar to *M. salictella,* but with the silvery markings more restricted, even the antemedial fascia being sometimes reduced to a bar on inner margin. (*Phyllocnistis* Chambers.)

The larva makes a very complexly winding and anastomosing linear mine with a central frass-line on leaves of *Smilax hispida* and *glabra.* The mine is about 2 mm. wide.

Cincinnati, Ohio; southern Kentucky.

7. **M. serotinella** Busck. Ground dark brown, slightly shining, not powdery. Similar to *M. salictella,* but with the first fascia nearly as wide as long, and much widened on the inner margin, with a sharply bent outer boundary; twice as wide as second fascia. Fasciæ not black-edged.

Larva on *Prunus serotina* (type only seen).

M. pomonella, a dark species with small alternating spots only, similar to *opuntiella,* is a western species feeding on apple; and is to be looked for in the north of our territory.

8. **M. apocynella** Braun. Head whitish on face, more yellow above, fuscous, as usual, on vertex; palpi whitish, second joint tipped with fuscous; antennæ gray. Fore wings black; antemedial fascia straight; an oblique fascia at middle, slightly angulate above inner margin; a larger costal and a minute dorsal one two-thirds way out; a white, costal streak before the apex; tip of fringe whitish. Legs black, annulate with white; four outer segments of tarsi mostly white.

Larva in a long, whitish, serpentine mine on *Apocynum cannabinum*; cocoon typical, with bubbles. Larva in early July, the moth later in the month.

The moth is smaller than *salictella,* with a yellower head and more oblique median fascia.

Southern Ohio.

9. **M. auratella** Braun. Golden bronze; face metallic lead-gray, including antennæ; tips of both palpi whitish; fore wing with brilliant, silvery markings; antemedial fascia a fourth way out, wider below fold; an oblique costal streak halfway out, and a more erect one just beyond it on inner margin; triangular costal and dorsal streaks two-thirds way out, nearly meeting; and a fine streak across wing near apex. Apical fringe white. 6½ mm.

There are two broods, in early June and in early August. The larva is a basal miner in *Rudbeckia laciniata* (so far as known, only in the cultivated golden glow) and in Dahlia. The mine is long, serpentine, usually tending downward, in the lower part of the stem. The cocoon is spun in a flap loosened from the cover of the end of the mine, opening not directly outward but by a silk-lined tunnel through the tissues of the flap; it is without pearl globules. This species possibly was introduced, with its food, from Mexico.

Southern Ohio.

7. *PARECTOPA* Clemens

(*Gracilaria, Coriscium,* in part)

Similar to Gracilaria; the vestiture of the vertex often raised, but without a definite tuft; middle tibiæ with at most a small tuft at apex; hind tibiæ smooth-scaled. Venation of fore wing slightly variable, one or two veins sometimes lost. Hind wing with M_3 lost; M_1 and M_2 and Cu_1 and Cu_2 stalked. Larva, when mature, of the cylindrical type; the northeastern species making a digitate blotch-mine, but some of the primitive species in a cone, like Gracilaria.

Key to the species

1. Inner margin white ..... 1. *salicifoliella.*
1. Inner margin concolorous, with short, silver fasciæ.
   2. A black streak through the white apical fringe; head all concolorous; third and fourth costal and dorsal bars opposite each other, forming broken fasciæ ..... 5. *plantaginisella.*
   2. Less black in apical fringe, otherwise marked; face white.
      3. Most of vertex behind antennæ light brown, white at edges; ground of fore wing paler ..... 4. *pennsylvaniella.*
      3. The part of head behind antennæ with front half white, posterior half blackish, contrasting, ground of fore wing darker. 2. *robiniella,* 3. *lespedezæfoliella.*

I. *Hind wing with traces of* M_3 *preserved; fore wing with* R_1 *arising from near base of cell;* R_5 *and* M_1 *stalked, and all veins preserved.* (Micrurapteryx *Spuler*).

1. P. salicifoliella Chambers. Apical fringe caudate, but with the tuft not contrastingly colored. Head and thorax white, with some gray scaling on head, especially on the two fanlike tufts over the bases of the antennæ; palpi with second joint mostly blackish; third joint with black rings at base, middle, and apex; maxillary palpi blackish. Legs black and white barred. Tegulæ and fore wing dull dark fuscous, lighter toward the margins. Two strongly oblique, white streaks at middle of costa, and three short, strongly convergent ones toward apex. Apex black, with a blackish bar around it in the fringe. Inner margin with a somewhat irregular white fascia, edged above with black, and sometimes containing a black bar near its upper edge, two-thirds way out, and scattered black scales. 10 mm.

The species occurs in the latter half of the year, apparently breeding continuously. The larva is a blotch-miner on willow, sometimes eating out the entire leaf, and is usually confined to a single mine. The pupal stage is passed under a silken carpet, on a leaf, and lasts two weeks.

Kentucky; southern Ohio; Missouri.

II. *Hind wing with* M_3 *lost; fore wing with* R_1 *arising a third way out on cell;* M_1 *free and one or two dorsal veins lost.* (Parectopa.)

2. P. robiniella Clemens. Dark brown, somewhat shining, but less so than *pennsylvaniella.* Head white, occiput black, the black area covering the whole width of the head. Palpi blackish, third segment white; antennæ with scape white, with a fine black line in front, shaft blackish, and feebly annulate. Legs banded, black and white. Fore wings with three white fasciæ strongly outwardly oblique from costa toward middle, the first one shorter; an antemedial, white, dorsal spot or fascia, not always reaching inner margin and nearer the base than the first costal; a short oblique fascia before the second costal, and one nearly opposite

he third; a fine, vertical, white stripe across the apex, usually interrupted in iddle. Fringes white, the costal and dorsal each with two black lines, which con-erge to the apex. Apex black, but not caudate; first dorsal line interrupted just elow the apex.

Larva in a digitate mine on locust.

Pennsylvania to Missouri; New York: Ithaca (mines not rare).

3. **P. lespedezæfoliella** Clemens. Similar; first costal fascia absent; dorsal fasciæ educed to spots (*mirabilis* Frey and Boll).

Larva on Lespedeza and perhaps Desmodium, marking several small, digitate ines; the frass thrown outside through a hole on the under side. Cocoon white, utside the mine, often on the ground.

Pennsylvania.

4. **P. pennsylvaniella** Engel. Rich golden brown; head white; vertex light brown, hite above eyes; palpus white, with most of second segment and a spot on third rown; apex of second segment white; maxillary palpi dark, with terminal joint hite. Scape of antenna brown above, white below, without fine stripes. Fore ing with three strong silvery fasciæ on costa, outwardly oblique; the first fascia ardly if at all shorter than the other two; and a short, triangular, white spot efore the apex. Dorsal margin with a strong, nearly longitudinal dash from ear base to fold a quarter way out; two oblique fasciæ before and beyond middle, nd a white bar in fringe opposite the last costal spot. All fasciæ edged with lack. A black and blue ocellate spot just below and before apex. Fringe with strong black hook in the apex, with a white area below it, preceded by a black ine across the extreme apex of the membrane; dorsal fringe below the white patch ray, not barred. 9 mm.

May, August, October. Larva on *Aster cordifolia*; the mine large and inflated hen mature.

Connecticut to western Pennsylvania.

5. **P. plantaginisella** Chambers. Golden brown, lighter than *P. pennsylvaniella*. he markings more heavily black-edged. Head bronze-brown, with a little white bove the mouth and along the eyes; palpi bronze on outer side, mostly white vithin; thorax as in the proceeding species. Fore wing with the three costal asciæ almost half as wide as the space between them; a subapical silver dot, with white bar in the fringe opposite it; inner margin with basal dash in fold, a short ilver bar at middle, and a longer one three-fourths way to apex, with its tip lmost touching the third costal one. A strong silver subterminal spot, opposite he tip of the third costal, continued by a white bar in fringe. Apical ocellus vith a large silver center. Fringe black, strongly caudate, with a white triangle elow the apex. 7 mm. (*erigeronella* Chambers, *geiella* Chambers).

September to November. Larva in a yellowish mine, which is at first slender nd frass-filled, but later becomes a large inflated blotch; on Erigeron and Plan-ago. Pupa on the ground.

Kentucky; Missouri.

8. *CREMASTOBOMBYCIA* Braun

Annette F. Braun

Face smooth, vertex rough-tufted. Labial palpi moderate, porrected or drooping, ointed. Maxillary palpi minute. Antennæ about as long as the wings; basal egment thickened; with slight pecten. Fore wings (fig. 119) lanceolate; R_1 and R_4 bsent, M_1 absent, M_2 and M_3 short stalked; **Cu** single-branched; **2d A** simple. Hind wings about one-half as wide, linear-lanceolate; M_1 and M_2 stalked; the ase of **M** sometimes distinct; M_3 absent; **Cu** single-branched; discal vein absent etween **Cu** and M_2. Posterior tibiæ with loosely appressed hairs.

The larvæ are similar to those of the cylindrical larval group of Lithocolletis. All of our species mine leaves of Compositæ, forming wrinkled, tentiform mines. They pupate in an elongate, dense, white cocoon sometimes ornamented with longitudinal ridges. This cocoon is suspended inside the mine by two slightly diverging silken threads at the posterior end, and by either one or two threads at the anterior end.

The markings of the fore wings consist of a more or less distinctly developed basal streak, four white costal streaks, and two or three dorsal streaks. There may be one or two more or less distinctly angulated fasciæ, formed by the confluence of opposite streaks.

Key to the species

A. Basal streak distinct, reaching almost to, or beyond, the basal fourth.
B. Basal streak narrow, pointed, unmargined.....1. *solidaginis*
BB. Basal streak dilated posteriorly.....2. *ambrosiella*
AA. Basal streak minute or wanting; markings silvery.....3. *ignota*

1. **C. solidaginis** Frey and Boll. Fore wings reddish ocherous; a narrow, whitish basal streak below fold; costal, oblique streak at one-third, oblique costal and dorsal streaks at one-half, usually meeting in middle of wing; two posterior costal, and one posterior dorsal, streak, all margined outwardly with blackish scales. 7–9 mm. Underside miner in leaves of golden rod, *Solidago* sp.

Distributed over the entire United States.

2. **C. ambrosiella** Chambers. Fore wings reddish orange; a short, posteriorly dilated, white basal streak; an oblique costal streak at one-fourth, a more or less angulated median fascia; two posterior, costal, and one posterior dorsal, streak all dark margined externally. 5.5–6.5 mm. Mine on underside of Ambrosia and Actinomeris; not projecting conspicuously on upper surface.

3. **C. ignota** Frey and Boll. Distinguished from the preceding by the silvery luster of the markings and the very short, indistinct basal streak. 6.5–7.5 mm. Tentiform mine on under surface of leaves of Actinomeris, Helianthus, and other Compositæ. Conspicuous as a tubercular swelling on upper side.

9. *LITHOCOLLETIS* Hübner

Annette F. Braun

Face smooth, crown rough-tufted. Labial palpi porrected or drooping, moderately long, pointed. Maxillary palpi rudimentary. Tongue moderate. Antennæ nearly attaining the wing length; simple in male; basal joint thickened; bearing a pecten (except in *desmodiella*). Fore wings (fig. 120) lanceolate; R_1 and R_2 absent, M_1 absent, M_2 and M_3 coincident; **Cu** single-branched; **2d A** simple. Hind wings about one-half as wide, linear lanceolate; M_1 and M_2 coincident, M_3 absent; **Cu** single-branched; discal vein absent between **Cu** and M_{1+2}. Posterior tibiæ with loosely appressed hairs.

Our representatives fall naturally into two distinct and well defined groups, identical, however, in the structural details of the imago. The first group, comprising those species having a cylindrical larva, agrees closely with the European species in the early stages and in the type of markings of the imago. The second group includes all those species having a flattened larva, and is characterized by a definite type of wing marking.

The following characters will separate the two groups:

Larva cylindrical; white streaks and fasciæ dark margined internally....Group I.
Larva flattened; white streaks and fasciæ dark-margined externally (p. 195).....Group II.

Group I

The larva of the first group is cylindrical or subcylindrical in form, and has, eside the thoracic legs, four pairs of prolegs, on segments 7, 8, 9, and 13. It is sually of a pale greenish or yellowish color.

The mine may be placed on either the upper or lower surface; but in either ase, the loosened epidermis is lined with silk, causing it to contract, and thus roducing a roomy, tent-like mine. The mine is at first narrow and somewhat inding, but soon spreads out into a blotch, which sometimes includes the earlier, inding part. The outline of the loosened epidermis represents the final size of he mine, no further increase taking place. The mine may be oval or circular, r, in rare instances, nearly rectangular in shape, sometimes limited by two veins. Jsually the larva feeds from the circumference inwardly; sometimes it begins t one end and sometimes it feeds irregularly in spots.

With the exception of *ostensackenella*, which leaves the mine to pupate, the upa is formed within the mine, and may or may not be enclosed in a cocoon. When not in a cocoon, it is usually suspended in the mine by a thin meshwork of ilken threads. When a cocoon is present, several varieties may be distinguished. The cocoon may be rather small, ovoid, formed of frass and silk; or large, loosely woven, semitransparent, occupying sometimes nearly one-half the mine; or an oval ring with outlines formed of frass.

The fore wings of the imagoes are usually of some shade of yellow or brown, ometimes, however, with the basal two-thirds almost pure shining white. Upon his yellowish ground color, the more or less white markings appear. The transverse markings consist of costal and dorsal streaks, usually curved and oblique, nd slightly curved or angulated fasciæ, or combinations of these. These streaks, r fasciæ, are usually margined with darker scales toward the base; the internal nargins of some of the streaks are sometimes lacking. In a few species, some r all of the streaks, or fasciæ, may be more or less margined externally also; ut in no case is the external margin heavier than the internal one, or is an xternal margin present, when the internal one is absent. Longitudinal markings, hen present, consist of a median streak from the base, sometimes accompanied y streaks along the costal and dorsal margins. The apex sometimes contains well-defined, regularly shaped, black dot, formed of closely overlapping scales. n other species, these scales are more or less scattered. The hind wings are nicolorous.

Key to the species

A. Ground color of the fore wings pure white, marked with fuscous, irrorated bands and bars.....2. *bataviella.*

AA. Ground color of the fore wings not entirely pure white.

B. Fore wings dusted with fuscous scales.

C. Costal and dorsal streaks large, conspicuous, and curved backward 26. *salicifoliella.*

CC. Costal and dorsal streaks narrow, straight, forming angulated fasciæ 44. *celtifoliella.*

BB. Fore wings not dusted.

C. With an apical dot (indistinct in *obsoleta*).

D. Without a complete median fascia.

E. One white dorsal streak before the tornus; basal half of wing mostly white.

F. Three white costal streaks.

G. Golden basal streak parallel to fold.....4. *quercialbella.*

GG. Golden basal streak parallel and almost contiguous to costa for half its length.....3. *trinotella.*

FF. Four white costal streaks.
G. Basal half of fore wings pure white.....5. *clemensella*
GG. A golden basal streak from base to near middle.
H. Basal streak margined with dark brown on its lower edge
6. *argentifimbriella*
HH. Basal streak unmargined .....7. *lucidicostella*
EE. Two white dorsal streaks before the tornus.
F. With a median pale basal streak.
G. Basal streak extended across the fold to the dorsum....9. *hageni*
GG. Basal streak not extended to the dorsum.
H. First dorsal streak short and broad, produced to base
8. *albanotella*
HH. First dorsal streak extending more than halfway across the wing.
I. A white costal streak from base to one-third.....17. *rileyella*
II. No such streak.
J. Basal streak dark margined toward costa.
K. First dorsal streak very long, reaching apex of second costal .....13. *obscuricostella*
KK. Apex of first dorsal streak opposite that of first costal.
L. Head and thorax white.....15. *olivaeformis*
LL. Head and thorax reddish suffron.....18. *kearfottella*
JJ. Basal streak unmargined.
K. Thorax and basal portion of fore wings shining white
16. *caryaealbella*
KK. Thorax and basal portion of fore wings not white
14. *ostryaefoliella*
FF. Without a median pale basal streak.
G. Apex of first dorsal streak opposite the apex of second costal.
H. First dorsal streak very large.....1. *fitchella*
HH. First dorsal streak not larger than opposite costal streak
32. *robiniella*
GG. Apex of first dorsal streak opposite the apex of first costal.
H. Pale markings very indistinct.....12. *obsoleta*
HH. Pale markings well defined.
I. Apex of second dorsal streak opposite the space between the second and third costal streaks; margins of opposite streaks never uniting .....11 *sexnotella*
II. Apex of second dorsal streak opposite second costal; margins of opposite streaks uniting.....10. *œriferella*
DD. With a complete median fascia.
E. Three posterior costal streaks.....37. *martiella*
EE. Two posterior costal streaks.
F. Dorsal half of the wing below the fold dark brown.
G. A silvery basal streak in the fold.....30. *morrisella*
GG. No basal streak.....31. *uhlerella*
FF. Dorsal half of the wings not darkened.
G. Fascia near middle.....35. *gemmea*
GG. Fascia at one-third; basal streak very short.....36. *diversella*
CC. Without an apical dot.
D. Oblique costal and dorsal streaks, rarely meeting; no straight fascia; sometimes one acutely angulated fascia.
E. Basal streak very short and indistinct.....29. *auronitens*
EE. Basal streak long.
F. A median angulated fascia of equal width throughout; white marks dusted internally .....33. *celtisella*

FF. Fascia, if present, formed by the meeting of opposite streaks.
G. With three, long, dorsal streaks before the tornus.
H. Five costal streaks.....27. *argentinotella.*
HH. Two costal streaks, first opposite second dorsal streak
28. *occitanica.*
GG. With two dorsal streaks before the tornus.
H. Basal streak unmargined or margined toward its apex only.
I. Basal streak confluent with the upper edge of the first dorsal streak.
J. Fore wings, pale, grayish.....23. *salicivorella.*
JJ. Fore wings not grayish.....24. *deceptusella.*
II. Basal streak not confluent with first dorsal streak.
J. First pair of streaks very oblique and extended along the margins to base.....34. *basistrigella.*
JJ. First pair of streaks not extended to base..22. *scudderella.*
HH. Basal streak dark margined toward the costa.
I. Costal margin white from base to near one-third..25. *populiella.*
II. Costal margin not white from base.
J. Three costal streaks.....21. *malimalifoliella.*
JJ. Four costal streaks.
K. First dorsal streak beginning much nearer the base than first costal; expanse 8–9 mm..19. *propinquinella.*
KK. First dorsal streak beginning nearly opposite first costal; expanse 6.5–7 mm.....20. *cratægella.*
DD. Usually two complete fasciæ; if but one, median and nearly straight.
E. A median fascia; two posterior costal streaks.
F. Basal portion of the wing shining white.....39. *lucetiella.*
FF. Basal portion of the wing golden.....38. *symphoricarpella.*
EE. Two complete fasciæ.
F. Head and thorax pure white.....46. *tiliacella.*
FF. Head and thorax not white.
G. Two posterior costal streaks.
H. Fasciæ nearly straight.
I. Ground color ocherous.....42. *tritæniella.*
II. Ground color of entire wing dark, reddish brown
40. *desmodiella*
III. Head and base of wings dark brown.....41. *ostensackenella.*
HH. Fasciæ distinctly bent outward near the middle..43. *mariæella.*
GG. Three posterior costal streaks.....45. *fragilella.*

1. **L. fitchella** Clemens. Head and thorax white. Fore wings reddish saffron with ive, white, costal streaks, the first produced along costa to base; three dorsal treaks, the first before the middle, very large; the second opposite the third costal treak; a black apical dot. 7.5–8 mm.

Tentiform mine on under side of leaves of oak, preferably *Quercus macrocarpa* nd *Q. bicolor.*

2. **L. bataviella** Braun. White, marked with angulated fasciæ composed of ray-tipped, golden-fuscous scales; a fascia at basal fourth produced along margins o the base; an angulated fascia at middle of wing, followed by a Y-shaped mark, vith its arms on costa, and its outer margin emitting a line of scales connecting vith a curved fascia near apex. Apex dark dusted. 7–7.5 mm.[15]

Ohio, local.

3. **L. trinotella** Braun. Head, thorax, and basal two-thirds of wing white; apical

[15] Larva on oak (Murtfeldt, in Cornell collection) W. T. M. F.

third pale golden. A pale golden basal streak parallel and close to costa for one fourth, thence deflexed and passing into golden apical part. In apical part three white costal streaks and two dorsal streaks, the first at tornus, opposite first costa. Black apical dot. 5–6 mm.

Ohio; New Jersey.

An underside miner in leaves of red and silver maple.

4. **L. quercialbella** Fitch. Distinguished from the preceding by the straight basal streak parallel to fold, darker margins to white streaks, and slightly darker color and larger size. 7 mm.

An underside miner in leaves of oak.

5. **L. clemensella** Chambers. White; apical half of wings golden, with four costal and three dorsal, dark-margined white streaks, the dark margin of the first costal streak oblique and produced along costa toward base; first dorsal at tornus opposite second costal. Black apical spot. 6–6.5 mm.

Underside miner in leaves of sugar maple.

6. **L. argentifimbriella** Clemens. Costal and dorsal streaks as in *L. clemensella*; in addition, a long, golden, basal streak, margined with dark brown along its lower edge. 6.5–7 mm.

An underside miner in leaves of oak, especially white oak.

7. **L. lucidicostella** Clemens. Differs from the preceding by the pale, unmargined golden, basal streak and the partial suffusion of the wing with gold below the fold. 6.5–7 mm.

An underside miner in leaves of sugar maple.

8. **L. albanotella** Chambers. Head white, with a few brownish scales; thorax white. Fore wings pale golden brown with a broad, white, dark-margined, basal streak; four white costal streaks, the first very oblique; opposite it, a broad white dorsal streak, dark-margined on its upper edge, is continued as a broad band along dorsal margin to base, where it is confluent with the basal streak; two posterior dorsal streaks; a black apical spot. 6–7.5 mm.

Ohio; Kentucky; Texas.

Rather small, tentiform mines on underside of leaves of oaks; usually at the edge of the leaf; with the loosened epidermis in numerous parallel ridges.

9. **L. hageni** Frey and Boll. Head and thorax white. Fore wings saffron brown; four, small, white costal streaks, dark-margined on both sides; a large, dorso-basal white patch, outwardly concave, occupying the basal fifth of wing except along costa (this patch is rarely extended to costa); a large curved white spot at middle of dorsum, and a triangular spot at tornus, both dark-margined on both sides. Apical spot usually present. 7.5–10 mm.

An underside miner in leaves of oaks, especially *Q. bicolor*.

10. **L. æriferella** Clemens. Tuft on head dark brown; wings reddish saffron with four white costal streaks, the first, in the middle of the wing, oblique; three dorsal streaks, the first large and oblique, margined inwardly and around the tip; margins of the second and third dorsal streaks, in the middle of the wing, where they are dull leaden-colored, unite with the margins of the corresponding costal streaks; margin of second dorsal streak usually heavy and conspicuous. A black apical spot preceded by bluish scales. 7–8.5 mm.

An underside miner in leaves of oaks, particularly chestnut oaks and shingle oak (*Quercus imbricaria*); distinguished by the dense, ovoid cocoon of frass and silk.

11. **L. sexnotella** Chambers. Differs from the preceding in the following respects: pale golden ground color; purer white costal and dorsal streaks, more posterior position of the second dorsal streak, whose apex is opposite the space between the second and third costal streaks; the margins of opposite streaks not uniting. 7–7.5 mm.

Kentucky; Pennsylvania.

12. **L. obsoleta** Frey and Boll. Wings ocherous, with markings as in the preceding species, but not clearly defined, and sometimes almost entirely obscured by suffusion with ground color. 8 mm.

Massachusetts.

13. **L. obscuricostella** Clemens. Hade white; forewings pale golden, with a white asal streak dark margined above; four, dark-margined, costal streaks, the first ery oblique; three dorsal streaks, the first very long, reaching apex of second ostal; second dorsal obliquely opposite third costal; apical spot black. 6–6.5 mm. Underside, slightly wrinkled mines between veins of leaves of hop hornbeam (*Ostrya virginiana*).

14. **L. ostryaefoliella** Clemens. Fore wings pale golden, with an unmargined, iedian, basal streak, and a white streak along base of inner margin; four costal, and hree dorsal, white streaks, the first pair oblique with apices opposite. 6–6.5 mm. Large wrinkled mines on underside of leaves of hop hornbeam; dense cocoon f frass and silk.

15. **L. olivaeformis** Braun. Head and thorax white; fore wings pale brownish cherous; a median, white, dark-margined, basal streak; base of dorsum narrowly hite; four costal and three dorsal streaks, first pair oblique with apices opposite; argin of first dorsal bent backward on fold; small black spical spot. 6.5–7 mm. Ohio.

An underside miner in leaves of hickory and pecan (*Carya* spp.); cocoon of rass and silk.

16. **L. caryaealbella** Chambers. Head, thorax, and base of fore wings, before the ostal and dorsal streaks, white, except for a wide, golden streak along costal argin to first costal streak and a partial suffusion below fold with golden; four ostal, and three dorsal, white streaks, on a pale-golden ground color; black apical pot. 6.5 mm.

Kentucky; Wisconsin.

Tent mine on underside of hickory leaves; cocoon of frass and silk.

17. **L. rileyella** Chambers. Wings golden; a white, unmargined, basal streak; ive costal white streaks, the first, before the middle, produced along the costa to he base; three dorsal streaks, first large, with its apex opposite apex of second ostal; apical spot small. 7–8 mm.

Missouri; Texas; Ohio.

Tentiform mines on underside of oak; in Ohio, on *Quercus imbricaria*.

18. **L. kearfottella** Braun. Head, thorax, and fore wings reddish saffron; a dark- argined, white, basal streak; first costal at one-third, produced along costa to asal fourth; first dorsal large; apical dot large. 7 mm.

Elongate mines on lower side of leaves of chestnut.

19. **L. propinquinella** Braun. Tuft dark brown; thorax and fore wings brownish golden; fore wings darkened with brownish scales in the middle, from second pair f streaks to apex, and in dorsal half of wing; basal streak long, dark-margined above and around its apex; a short, dorso-basal, white streak; four costal, and hree dorsal, white streaks, the first pair very oblique, the dorsal one of the pair eginning much nearer the base than the costal. 8–9 mm.

An underside miner on wild cherry, *Prunus serotina*.

20. **L. crataegella** Clemens. Similar to the preceding in color and markings, ut differing in the smaller size and less oblique first pair of streaks, of which he dorsal streak begins nearly opposite the costal. 6.5–7 mm.

Small, underside mines on apple, *Crataegus* and *Prunus*.

21. **L. malimalifoliella** Braun. Color as in *L. crataegella*, from which it differs y the *three*, equally spaced, costal streaks. 5.5–6 mm.

Underside miner on apple and quince; mine wrinkled, speckled above.

22. **L. scudderella** Frey and Boll. Head, thorax, and fore wings pale yellowish rown. Basal streak long, margined around apex only; four costal and three orsal white streaks, first pair very oblique, blackish internal margining often ndenting first dorsal on fold; when this accumulation of dark scales is absent, he first dorsal streak appears less oblique. A streak of black scales in apex, argined above and before with white. 7.5–9 mm.

Underside miner on willow, *Salix* spp.

23. **L. salicivorella** Braun. Color pale grayish, with four costal, and thre dorsal, white streaks, and a white basal streak confluent with the upper edge the first dorsal streak. 7 mm.

New Jersey.

Underside miner on willow.

24. **L. deceptusella** Chambers. Color *golden brown;* four costal, and three dorsa white streaks, and a white basal streak confluent with upper edge of first dorsa an elongate patch of brown scales in apex. 6 mm.

Kentucky.

25. **L. populiella** Chambers. Head white; wings pale golden; three white bas streaks, costo-basal, median, and dorso-basal, respectively; four costal, and thr dorsal, white streaks, large, broad, and but little oblique. 6–7 mm.

Ohio; Kentucky.

An underside miner in leaves of silver-leaved poplar, *Populus alba.*

26. **L. salicifoliella** Clemens. Head white; tuft often with brown scales. Fo wings golden or brownish-yellow with white streaks; both streaks and groun color typically dusted with black scales (in some forms, dusting entirely absent A short, median, basal streak and dorso-basal streak uniting with a dorsal strea at the basal fourth, enclosing a small patch of ground color; two oblique cost streaks, curving backward along the middle of the wing, and three, posterio less-oblique, costal streaks; first dorsal streak oblique, curving backward, an usually confluent with the first two costal streaks; a triangular spot at tornu followed by a curved streak usually uniting with the opposite, costal streak. 7–8 mm.

An underside miner in leaves of poplar and willow. Moths appearing in Augus usually lack the black dusting.

27. **L. argentinotella** Clemens. Wings golden yellow with a white basal strea to one-fourth, five costal streaks, three dorsal streaks before the tornus and on beyond. 6.5–8 mm.

An underside miner in leaves of elm.

28. **L. occitanica** Frey and Boll. Differs from the preceding only by the absenc of the first and last two costal streaks of that species and may not be distinc Reported only from Texas. An underside miner on elm.

29. **L. auronitens** Frey and Boll. Wings brownish golden; a very short basa streak; a long oblique costal streak at one-fourth and an opposite dorsal spot a pair of triangular streaks in middle of wing whose apices meet; two poste rior costal, and two dorsal, streaks. 6.5–8 mm.

Massachusetts; North Carolina.

An underside, rather large, much-wrinkled mine on alder. *Alnus* spp.

30. **L. morrisella** Fitch. Tuft dark brown; thorax and fore wing, below th fold, dark brown; remainder of wing golden brown; markings silvery white. silvery basal streak uniting at one-third with a white dorsal streak; costa streak at one-third; a convex fascia at middle; beyond this, two perpendicula costal streaks, and opposite the first of these a dorsal streak. In the fold betwee this streak and the fascia, a velvety black streak. Apical spot large, velvet black. 6–7 mm.

Underside whitish mines on hog peanut, *Amphicarpa monoica.*

31. **L. uhlerella** Fitch. Differs from *morrisella* by the absence of the silver basal streak and the less brilliant luster of the white markings.

Whitish, rather flat mines on underside of leaves of *Amorpha fruticosa.*

32. **L. robiniella** Clemens. Agrees with the two preceding in color and genera type of markings; no basal streak; first dorsal streak but faintly indicated median fascia replaced by opposite oblique streaks. 6–6.5 mm.

Under or upper side mines on locust, *Robinia pseudo-acacia;* white silken cocoo within the mine.

33. **L. celtisella** Chambers. Fore wing ocherous, with a long, white, basal streak, dark-margined above; an angulated, median, white fascia; a straight fascia at three-fourths, formed by confluent streaks; both fasciæ margined internally with dense dusting; apex white, densely dusted with dark brown. 6–7 mm.

Ohio; Kentucky.

Mine on leaves of blackberry, *Celtis occidentalis*; at first linear on lower side, then expanding to a blotch on upper side, made tentiform by a longitudinal ridge.

34. **L. basistrigella** Clemens. Fore wings golden yellow; a long, narrow, median, basal streak; a pair of very oblique, linear, costal and dorsal streaks of equal width throughout and produced along the margins to the base; three posterior costal, and one dorsal, white streak. 8 mm.

An underside miner on leaves of oaks; mine scarcely wrinkled; cocoon flat, outlined by a characteristic oval ring of frass.

35. **L. gemmea** Frey and Boll. Fore wings reddish saffron; basal streak to one-third, dark-margined above and below, near middle a nearly straight fascia; two posterior costal, and two dorsal, white streaks; a large brown spot in apex. 6–7.5 mm.

Massachusetts.

An upperside miner on leaves of locust.

36. **L. diversella** Braun. Thorax and base of wing sometimes deep, metallic golden, wing elsewhere golden or reddish brown; markings silvery or white. A very short basal streak; an almost straight fascia at one-third; two posterior costal, and two dorsal, white spots; an irregular, dark-brown, apical spot, preceded by white scales. 5–7 mm.

Ohio; Kentucky;

Underside mines on huckleberry, *Gaylussacia*, and on sorrel tree, *Oxydendrum arboreum*.

37. **L. martiella** Braun. Fore wing reddish saffron; a white basal streak to one-third; a slightly curved, white fascia just before middle; three posterior costal, and two dorsal, white streaks; a black apical spot. 7 mm.

North Carolina; British Columbia.

Narrow, tentiform mines on under side of leaves of birch, *Betula* spp.

38. **L. symphoricarpella** Chambers. Fore wings brownish golden; a short, indistinct, basal streak; a slightly curved fascia just before middle; at beginning of cilia a second fascia, sometimes divided into opposite costal and dorsal streaks; an indistinct costal streak preceding dusted apex. 5.5–6 mm.

Ohio; Kentucky; Texas.

Small, tentiform mines on underside of leaves of *Symphoricarpos orbiculatus*.

39. **L. lucetiella** Clemens. Head, thorax, and basal half of fore wings white; apical part suffused with golden; a golden costal streak from base, not reaching middle. At about the middle, a white fascia, bordered with golden inwardly; and a black spot on costa inwardly; at beginning of cilia a pair of white streaks, black-margined inwardly; an unmargined white streak encircling apex. 6–7 mm.

Rectangular transparent mines on underside of leaves of basswood, *Tilia americana;* pupa contained in an oval cocoon.

40. **L. desmodiella** Clemens. Tuft dark brown; thorax and base of fore wing ruby-tinted; ferruginous brown beyond, with two silvery fasciæ, dark-margined on both sides; two posterior costal, and one dorsal white spot. 3–5 mm.

Tentiform mines on underside of leaves of various leguminous plants, such as *Desmodium, Lespedeza* and *Phascolus*. Larvæ often gregarious, in large, inflated mines.

41. **L. ostensackenella** Fitch. Head, thorax, and base of wing dark brown; remainder of wing brilliant golden brown. Two silvery, almost straight fasciæ, at one-fourth and one-half, respectively, shading outwardly into the ground color. Two posterior costal, and two dorsal streaks. 5.5–6 mm.

Mine a yellow blotch on upper or under side of leaves of locust; cocoon fla oval, yellow, spun outside the mine.

42. **L. tritænianella** Chambers. Thorax and fore wings pale reddish ocherous two straight white fasciæ, a third, sometimes almost divided into opposite streak and slightly angulated; an indistinct, whitish, costal streak near the ape 7–8 mm.

Tentiform mines on upper side of leaves of hop hornbeam; mine at first blotcl like and speckled, later wrinkled.

43. **L. mariæella** Chambers. Thorax and fore wings golden brown; two whit fasciæ, one at basal fourth, the other in the middle of the wing; both bent out ward near the median line and margined inwardly with dark brown; at thre fourths, a curved, white, costal streak meeting a similar dorsal streak; a whi streak encloses apex. 8–8.5 mm.

Missouri.

Tentiform mines on lower side of leaves of *Symphoricarpos orbiculatus.*

44. **L. celtifoliella** Chambers. Wings reddish saffron, with three, acutely angle white fasciæ, densely dusted internally with dark-brown, which often obscure the white; each of the first two fasciæ sending a white streak from its angl almost to the next fascia; the third running into a dusted costo-apical patcl a dorso-apical patch of dark dusting on a white ground; a median basal strea densely dusted dorsally, this dusting often confluent with a dusted, dorso-basa white patch. 6 mm.

Ohio; Kentucky; West Virginia.

Tentiform mines on underside of leaves of hackberry.

45. **L. fragilella** Frey and Boll. Fore wings brownish or deep reddish saffro with two, outwardly angulated, narrow, indistinct, but complete fasciæ at bas fifth and at two-fifths, respectively; a third nearly straight at three-fifths inte rupted in the middle by a projection from its internal margin; two posteri costal streaks, and a dorsal streak indicated by its margin. The fasciæ an streaks margined internally with dark dusting, the margins becoming broad the costa. Apex dusted. 8.5–9 mm.

Tentiform mines on underside of leaves of honeysuckle; *Lonicera* spp.

46. **L. tiliacella** Chambers. Head, thorax, and base of wings, except alon costa, pure white; middle part of wing to beyond beginning of cilia pale golde a few golden scales in apex; three white fasciæ, the first two straight and dar margined internally, the third slightly bent and its dark margin interrupted the middle. 6–7 mm.

Circular tent mines on upper side of leaves of basswood; mine white, speckl with brown.

47. **L. lysimachiæella** Chambers. Named from mine on underside of leaves *Lysimachia lanceolata.*

Group II

The larva of the flat group is very much depressed, almost flat, with the sid of the segments projecting, thus giving the entire larva a beaded appearance. T head is flat, somewhat triangular in shape, usually of a shining, reddish brow color, with the mouth parts projecting in front. The first three segments of t body are broader than the others and the body tapers toward the posterior en While the legs are of the same number and occupy the same position as in t cylindrical larva, all are very rudimentary, appearing as small, tubercular pr jections. On the upper and lower side of most, and sometimes all, of the bod segments, are distinctly outlined, shining, darker spots — the maculae. The vary in shape on the different segments, being elliptical or trapezoidal, but a constant for a given species in each stage. After the seventh, or last, moult, t larva assumes a more cylindrical shape; the legs are better developed; and t dark maculae gradually disappear.

All of the species are miners on the upper side of leaves, where they make a flat, sometimes irregularly shaped blotch, or a rather broad, linear tract. The larva feeds from the centre outwardly, thus gradually increasing the extent of the mined portion of the leaf. The mine retains its flat, blotch-like character until after the seventh moult. The larva then lines the loosened epidermis with silk and by contraction produces from one to three narrow folds or ridges. Beneath this folded portion, the floor of the mine is thinly covered with silk. Then the larva, lying on its back, spins a flat, semi-transparent sheet of silk, oval or nearly circular in shape, and attached around its edges to the floor of the mine. Beneath this, along its long axis, the pupa is formed. The pupa, which is protruded from the mine in emergence, is thrust through a transverse slit near one end of the flat cocoon. Such a cocoon is formed in all but a few of the species of which the life history is known.

In almost all of the species, however, this cocoon is only made in the brood of which the imagoes are to appear in the same summer. In a later brood, the hibernating period, with one or two exceptions, is passed in the larval state. In a number of species, hibernation takes place beneath the folded epidermis. In most cases, however, an especially prepared, silken-lined chamber is formed. After the floor of the mine is loosely covered with silk, the upper epidermis is fastened down in a circular or oval outline, and the whole cavity is then lined with silk. Ample space is provided by a characteristic oval, or hemispherical, projection upon the under side of the leaf. The change to pupa occurs in the spring. Except for the absence of cremaster, the pupa is identical with that of the cylindrical-larval group.

The moths of this group may easily be recognized by the fact that the white markings of the fore wings are always externally dark-margined, and often densely dusted with black scales behind. In some cases there is, in addition, a slight internal margin, consisting of a few dark scales near the costa. The markings consist of white costal and dorsal streaks, usually oblique. Opposite streaks may unite to form a fascia, either outwardly angulated or straight.

Key to the species

A. Oblique costal and dorsal streaks; fasciæ, if present, distinctly angulated; never two straight fasciæ.
  B. Ground color of the fore wings white.....48. *hamadryadella.*
  BB. Ground color of the fore wings not white.
    C. An oblique white streak or patch at the base of the dorsal margin, rarely indistinct (*lentella, caryaefoliella*) usually two, angulated fasciæ.
      D. No costal streak before the middle; a median fascia..51. *saccharella.*
      DD. A fascia at one-fourth and one at one-half.
        E. White streak at base of dorsum indistinct, or indicated by external, dark scales only.
          F. Third costal streak long and usually uniting with the third dorsal .....52. *caryaefoliella.*
          FF. Third costal streak merely a spot.....53. *lentella.*
        EE. White streak at base of dorsum large and distinct.
          F. A tuft of brown scales in the apical cilia.....50. *macrocarpella.*
          FF. No such tuft of scales.....49. *cincinnatiella.*
    CC. No such pale streak at base of dorsum.
      D. Dorsal margin white from base to beyond middle.
        E. Dorso-basal streak extending to oblique streak above the cilia.
          F. Antennæ annulate with brown for their whole length.
54. *conglomeratella.*
          FF. Basal third of antennæ pure white.....55. *ulmella.*
        EE. Dorso-basal streak extending but little beyond the middle of the dorsal margin .....56. *quercivorella.*

DD. Dorsal margin not white.
E. With two costal streaks or spots before the white streak or spo
forming the anterior edge of the apical dusting.
F. Ground color of wings pale, with a coppery lustre toward th
apex; marks very indistinct.....58. *cervino*
FF. Ground color saffron; marks white.....57. *platanoidiello*
EE. With at most one costal streak before the white streak or spo
forming the anterior edge of the apical dusting.
F. Median fascia but slightly angulated; other white marks small o
absent.
G. Costal and dorsal streaks absent.....64. *fasciello*
GG. Costal and dorsal streaks present.....65. *castaneaello*
FF. Median fascia sharply angulated; white marks conspicuous.
G. First dorsal streak long, oblique, curved.....59. *fletcherello*
GG. First dorsal streak perpendicular.
H. Marks dull white, faintly margined.....61. *betulivoro*
HH. Marks shining white, strongly margined.
I. External dusting at angle of fascia produced backward
apex densely dusted.
J. Hind tarsi white.....62. *bethunello*
JJ. Hind tarsi spotted with black.....63. *picturatello*
II. External margin of fascia not produced.....60. *arcuello*

AA. Two straight, or nearly straight, fasciæ, nearer the base on the dorsal margin
B. No costal streaks beyond fasciæ.....73. *tubiferello*
BB. A costal and a dorsal streak at three-fourths.
C. Without a paler streak at the base of the dorsal margin.
D. Apical dusting, black on a whitish ground, and extended to th
tornus .....66. *guttifinitello*
DD. Apex velvety black, dusting not extended to tornus..67. *obstrictello*
CC. With a white streak or paler shade from inner angle to fold.
D. First fascia and its dark margin broken near the costa..68. *æsculisello*
DD. First fascia complete.
E. Color deep reddish.....69. *hamameliello*
EE. Color paler ocherous.
F. Dorsal streak at tornus very oblique and pointing toward apex.
G. Apex not dusted.....70. *aceriello*
GG. Apex dusted .....71. *ostryarello*
FF. Dorsal streak at tornus less oblique.....72. *corylisello*

48. **L. hamadryadella** Clemens. Head, thorax, and fore wings white. Win markings as follows: a small patch of black scales at base of costa; a slightl angulated band of black dusting on an ocherous ground, followed by an angulate line of black dusting; an angulated ocherous fascia at one-third, broadly duste internally with black scales; a second, similar fascia just beyond the middle; th space between these two fasciæ marked by a line of black scales; a similar lin of scales between the second fascia and costal and dorsal patches, which are sep arated from one another in the middle of the wing by a patch of dark dusting apex ocherous, dusted with black. 6.5–8.5 mm.

Irregular, whitish blotch mine on upper side of leaves of oak, especially *Quercu alba*, rarely (perhaps accidentally) on *Magnolia* and *Ostrya*.

49. **L. cincinnatiella** Chambers. Fore wings shining ocherous; a curved whit streak from base of inner margin to fold, dusted outwardly with black scales; tw angulated fasciæ, at one-third and one-half, respectively, dusted externally wit black scales, the dusting produced at the angle; at two-thirds a small, duste

costal spot, beyond which is a white streak; an oblique dorsal streak from just before tornus sometimes extended to form inner margin of dusted apex. 6.5–7.5 mm.

Larvæ gregarious, in brownish-yellow, blotch mines on leaves of oaks, principally white oak.

50. **L. macrocarpella** Frey and Boll. Close to *cincinnatiella;* differs by the following characters: a small tuft of brown scales in apical cilia (wanting in *cincinnatiella*); larger size (8.5–9 mm.), darker, less shining ground color, more oblique, and slightly curved, dorsal arms of fascia.

Upper side blotch on oak; each mine with a single larva.

Eastern, southern, and western United States, chiefly near coast.

51. **L. saccharella** Braun. Fore wings ocherous; an oblique, curved, white streak at base of inner margin, usually uniting with an oblique dorsal streak at basal fourth; an acutely angled, slightly interrupted fascia at middle, a white costal spot beyond, and a long, oblique, dorsal streak opposite; apex densely dusted. 5–7 mm.

Small, irregular blotches on upper side of leaves of sugar maple, and occasionally on other maples.

52. **L. caryaefoliella** Clemens. Fore wings reddish ocherous; an indistinct, oblique, curved streak from base of dorsum; two angulated fasciæ, placed as in *L. cincinnatiella*; a third angulated fascia formed by the meeting of two, opposite, slightly oblique streaks; a small, white-dusted, costal spot beyond; apex black-dusted on a white ground. 6–7 mm.

Irregular blotches on upper side of leaves of hickory and, occasionally, of butternut and walnut.

53. **L. lentella** Braun. Markings at base and two angulated fasciæ as in preceding species; beyond second fascia, on costa, a broad white spot, margined on each side and below with black scales; opposite it a long, oblique, dorsal streak, opposite whose apex a second small, white-dusted, costal spot; apex of wing dusted with black on a white ground, 6.5–7 mm.

United States west to Arizona.

Blotch mines on birch and hop hornbeam, often containing several larvæ. Epidermis much wrinkled, bending leaf into a fold.

54. **L. conglomeratella** Zeller. Fore wings reddish saffron; two oblique costal streaks, at one-third and one-half, respectively; a costal spot at two-thirds; a narrow, white streak from base along dorsal margin nearly to tornus, then reflexed and passing obliquely toward apex, forming the inner margin of the apical dusting and sometimes partially obscured by the latter; a tuft of brown scales in the apical cilia. Antennæ annulate with brown. 7.5–9 mm.

New Jersey to Ohio; south and west to Texas and California.

Blotch mines on oak, especially live oak (*Quercus virginiana*).

55. **L. ulmella** Chambers. Differs from *L. conglomeratella* by the more oblique costal streaks, the absence of tuft of scales in apical cilia, and the white basal third of antennæ. 6.5–7 mm.

Blotch mines on upper side of leaves of elm.

56. **L. quercivorella** Chambers. Distinguished from both *ulmella* and *conglomeratella* by dorso-basal, white streak extending scarcely beyond the middle and not connecting with the oblique, dorsal streak before tornus. 6.5–7 mm.

A small blotch mine on upper side of leaves of oak, especially red oak (*Q. rubra*), and usually placed near the tip of a lobe.

57. **L. platanoidiella** Braun. Fore wings reddish ocherous; an oblique, costal streak at one-third; angulated fascia at middle, its external dusting being prolonged backwards at angle; a pair of white streaks at apical third; a small, white spot on costa between the costal streak of the pair and the white streak forming the inner margin of the apical dusting. 6.5–8 mm.

Blotch mines on upper side of leaves of oak, especially on *Quercus alba, Q. macr carpa,* and *Q. bicolor.*

58. **L. cervina** Walsingham. Distinguished from the preceding by the pale grou color of wings, their coppery luster toward apex, and the indistinct markings. 6 m New York.

59. **L. fletcherella** Braun. Fore wings reddish ocherous; a pair of costal a dorsal streaks at one-third, the dorsal one long, oblique, curved, with its point apex directed toward apex of costal streak; a median, angulated fascia; a pair opposite streaks at two-thirds; between these and a white streak before ape in middle of wing, a white spot. 8.5–9 mm.

Ottawa, Canada.

Blotch mines on white oak.

60. **L. arcuella** Braun. Fore wing reddish orange with markings shining whit first costal streak at one-third broader than long; first dorsal streak near perpendicular, rectangular; median angulated fascia, with dark margin not pr duced at angle; costal streak at two-thirds strongly curved; an opposite dors streak; a curved costal streak enclosing apex; apex dusted with blackish-brow scales. 10 mm.

Virginia.

61. **L. betulivora** Walsingham. Wings pale reddish ocherous and markin dull white, with faint margins; markings as in preceding, but streaks at tw thirds very indistinct, and dusted apex not enclosed by a white streak. 7 mm.

North Carolina.

Small, round, blotch mines on leaves of birch.

62. **L. bethunella** Chambers. Fore wing reddish orange; markings as in tw preceding species, except that first pair of streaks are longer and the costal o of the pair is decidedly oblique; the external dark dusting of the fascia produc at the angle to the space between the streaks, at two-thirds; apical dusting pr ceded by a white spot. Tarsi white. 6.5–7.5 mm.

Blotch mines on leaves of various species of oak.

63. **L. picturatella** Braun. Distinguished from the preceding by the conspicuou black spots near the ends of the tarsal segments. 6.5–7 mm.

Connecticut; New York; New Jersey.

Brownish blotch mines on upper side of leaves of bayberry, *Myrica carolinens*

64. **L. fasciella** Walsingham. Fore wings reddish orange; a median, ve obtusely angulated fascia, its external, dark dusting being produced backward in the apical dusting. No costal or dorsal streaks. 6–7 mm.

Ohio and Kentucky.

Oval blotch mines on leaves of various species of oaks.

65. **L. castaneæella** Chambers. Fore wings reddish orange; a small, whi costal spot at one-third; a median fascia very obtusely angled, its dustings exte ing backward to the costal streak at two-thirds; opposite this streak, a fai dorsal streak; a small, white streak before dusted apex; dusting behind fasc and in apex sometimes almost entirely lacking. 6–7.5 mm.

Oval, blotch mine on chestnut and oak.

66. **L. guttifinitella** Clemens. Reddish orange; two straight, or nearly straig fasciæ, at one-third and one-half, respectively; a costal spot at two-thirds a opposite it, a rather oblique, dorsal streak; apical dusting black on a whi ground and extended to tornus; a white streak along upper edge of dusting ne apex. 7 mm.

Mine a broad, tortuous tract, on poison ivy, *Rhus toxicodendron.*

67. **L. obstrictella** Clemens. Reddish brown; two, nearly straight, silvery fasci the second nearly perpendicular, opposite costal and dorsal streaks at two-thir

often uniting to form a third, nearly straight fascia. Apex velvety black, preceded by a few silvery scales. 7–8 mm.

Mine a broad, branched tract, usually Y-shaped, often crossing midrib, on leaves of oaks, most commonly chestnut oak. Passes the winter in pupal state, contrary to the usual habit of species of this group.

68. **L. aesculisella** Chambers. Reddish ocherous; a faint, whitish streak from base of inner margin to fold; two fasciæ; the first fascia and its dark margin broken near costa, slightly angulated, and its dorsal arm more oblique than the second fascia, the latter being nearly straight. At two-thirds, a costal spot and an opposite, longer, dorsal streak. 8–9 mm.

Central United States.

Mine a broad, linear tract, on leaves of buckeye, *Aesculus glabra* and *A. octandra;* often containing several larvæ.

69. **L. hamameliella** Busck. Deep reddish orange; an oblique white streak from base of inner margin to fold; two straight, oblique, silvery fasciæ; a silvery spot at two-thirds; a long, very oblique, opposite, dorsal streak, parallel to termen, uniting in apex of wing with a short apical streak. Marginal line in cilia distinct. 7 mm.

Mine a whitish blotch on leaves of witch-hazel, *Hamamelis virginiana.*

70. **L. aceriella** Clemens. Fore wings reddish ocherous; markings as in preceding species, except that dorsal streak at tornus is usually less oblique and marginal line in cilia not defined. 7–9 mm.

Mine a flat, broad tract, in leaves of maple, most commonly red maple.

71. **L. ostryarella** Chambers. Markings of the general character of the three preceding species, but distinguished as follows: first fascia concave outwardly on fold, more oblique than second; dorsal streak at tornus oblique; apex dusted with *dark brown.* 6–7 mm.

Irregular blotch mines on hop hornbeam (Ostrya) and ironwood (Carpinus); larvæ sometimes gregarious; hibernating chamber of winter outlined by a raised, circular ridge.

72. **L. corylisella** Chambers. Distinguished from the preceding species by the erect, dorsal streak at tornus. 6.5–7 mm.

Blotch mines on upper side of leaves of hazel, *Corylus americana.*

73. **L. tubiferella** Clemens. Head white; wings deep ocherous, with two straight, slightly oblique, white fasciæ; no costal or dorsal streaks; sometimes a minute, white spot in the apex. 7.5–8 mm.

Mine a very characteristic tract, gradually increasing in breadth, on leaves of oaks. Larva placed transversely in the mine.

Synopsis of species of Lithocolletis *by food plants*

Salix spp., willow:

L. scudderella. Tentiform mine on underside of leaf.

L. salicivorella. Tentiform mine on underside of leaf.

L. salicifoliella. Tentiform mine on underside of leaf.

Populus alba, silver-leaved poplar:

L. populiella. Small, tentiform, underside mine.

Populus spp., poplar:

L. salicifoliella. Rather large, tentiform, underside mine.

Myrica carolinensis, bayberry:

L. picturatella. Upper side, blotch mine.

Juglans cinerea, butternut:

L. caryaefoliella.

Juglans nigra, walnut:

L. caryaefoliella. Upper side, irregular, blotch mine.

Carya spp., hickory:
L. caryaealbella. Tentiform, underside mine; dense, ovoid cocoon of frass a silk.
L. olivaeformis. Tentiform, underside mine; dense, ovoid cocoon of frass a silk.
L. caryaefoliella. Upper side irregular, blotch mines, often confluent.
Corylus americana, hazelnut:
L. corylisella. Upper side, irregular blotch mine.
Ostrya virginiana, hop hornbeam:
L. obscuricostella. Small, slightly wrinkled, tentiform, underside mine; pu in a slight, silken web.
L. ostryaefoliella. Underside mine, larger than that of preceding species a more wrinkled; ovoid cocoon of frass and silk.
L. tritœnianella. Upper side, blotch mine; epidermis of leaf white, speckle and later, much wrinkled and leaf folded.
L. lentella. Brownish, upper-side, blotch mines, often containing several larv epidermis of leaf in numerous longitudinal ridges; leaf folded.
L. ostryarella. Irregular, flat, upper-side, blotch mines, usually containi several larvæ; hibernating chamber outlined by a circular ridge.
Carpinus caroliniana, ironwood:
L. ostryarella. (Described under Ostrya.)
Betula spp., birch:
L. martiella. Narrow, tentiform, underside mine.
L. lentella. (Described under Ostrya.)
L. betulivora. Small, nearly circular, upper-side, blotch mine.
Alnus spp., alder:
L. auronitens. Underside, rather large, tentiform mine.
Castanea dentata, chestnut:
L. kearfottella. Rather small, narrow, tentiform, underside mine, betwe veins.
Many upper-side miners on oak are also often found on chestnut. These min are described under Quercus.
Quercus spp., oaks:
Underside, tentiform mines:
L. fitchella. Large, tentiform mine; epidermis of leaf slightly and fine wrinkled; most commonly on *Q. macrocarpa* and *Q. bicolor.*
L. hageni. Mine similar to that of *fitchella.*
L. rileyella.
L. quercialbella.
L. argentifimbriella. Especially on white oak, *Q. alba.*
L. albanotella. Small mine, usually near margin; epidermis of leaf wi numerous, distinct, longitudinal ridges; especially on *Q. bicolor* and *macrocarpa.*
L. œriferella. Tentiform, wrinkled mine; ovoid cocoon of frass and silk especially on chestnut oak and shingle oak (*Q. imbricaria*).
L. basistrigella. Rectangular, transparent, scarcely wrinkled mine; fl cocoon outlined by ring of frass.
Upper-side blotches or flat broad tracts.
L. hamadryadella. Whitish, irregular, blotch mine.
L. cincinnatiella. Large, brownish blotches; larvæ usually gregarious; pri cipally on white oak.
L. macrocarpella. Blotch mine.
L. conglomeratella. Blotch mine, especially on live oak (*Q. virginiana*).
L. quercivorella. Small, blotch mine, usually near the tip of a lobe, especial on red oak (*Q. rubra*).

L. platanoidiella. Blotch mine.
L. fletcherella. Blotch mine on white oak.
L. bethunella. Small blotch mine.
L. castaneæella. Small blotch mine.
L. fasciella. Small blotch mine.
L. obstrictella. Mine a broad, branched tract, usually Y-shaped; most commonly on chestnut oaks.
L. tubiferella. Mine a broad, linear tract, gradually increasing in breadth and occasionally branched; larva placed transversely in mine.

Ulmus spp., elms:
L. argentinotella. Large, tentiform, underside mine.
L. occitanica. Tentiform, underside mine.
L. ulmella. Upper-side, blotch mine.

Celtis occidentalis, hackberry:
L. celtisella. Underside, linear mine, expanding into an upper-side blotch, with a longitudinal ridge.
L. celtifoliella. Underside, tentiform mine.

Hamamelis virginiana, witch-hazel:
L. hamameliella. Whitish, upper-side, blotch mine.

Pyrus malus, apple:
L. malimalifoliella. Small, tentiform, underside mine; also on quince.
L. cratægella. Small, tentiform, underside mine.

Cratægus spp., hawapple:
L. cratægella. Small, tentiform, underside mine.

Prunus serotina, wild black cherry:
L. propinquinella. Large, tentiform, underside mine.
L. cratægella. Tentiform mine, smaller than that of *L. propinquinella.*

Amorpha fruticosa:
L. uhlerella. Whitish, rather flat mines on underside of leaves.

Robinia pseudoacacia, locust:
L. robiniella. Under- or upper-side, white mines.
L. gemmea. Upper-side miner.
L. ostensackenella. Yellow, blotch mine, on upper or lower side. Larva leaves the mine to pupate.

Amphicarpa monoica, hog peanut:
L. morrisella. Large, white, tentiform, underside mine, sometimes containing several larvæ.

Desmodium spp., *Lespedeza* spp., and *Phaseolus:*
L. desmodiella. Tentiform, underside mine, sometimes inflated and containing several larvæ.

Rhus toxicodendron, poison ivy:
L. guttifinitella. A broad, tortuous, irregular tract on upper side of leaf.

Acer spp., maples:
L. clemensella. Underside, tentiform mine, on sugar maple.
L. lucidicostella. Underside, tentiform mine, on sugar maple.
L. trinotella. Small, underside, tentiform mine, on red and silver maple.
L. saccharella. Irregular, upper-side, blotch mine, chiefly on sugar maple.
L. aceriella. A flat, broad, tract on upper side; most commonly on red maple.

Æsculus spp., horse-chestnut, buckeye:
L. æsculisella. A broad, linear, upper-side tract, sometimes containing five or six larvæ.

Tilia americana, basswood:
L. lucetiella. Transparent, unwrinkled, underside mine; cocoon oval.
L. tiliacella. Circular, whitish, speckled, tent mine on upper side.

Gaylussacia spp., huckleberry:
L. diversella.
Oxydendrum arboreum, sorrel tree:
L. diversella. Tentiform, underside mine.
Steironema (Lysimachia) *lanceolatum:*
L. lysimachiœella. Small, tentiform, underside mine.
Lonicera spp., honeysuckle;
L. fragilella. Rather large, tentiform, underside mine.
Symphoricarpos orbiculatus, coral-berry:
L. symphoricarpella. Very small, underside, tent mines; half the mine part
tioned off to form a pupal chamber.
L. mariœella. Tent mines, larger than those of *L. symphoricarpella*; an ovoi
silken cocoon.

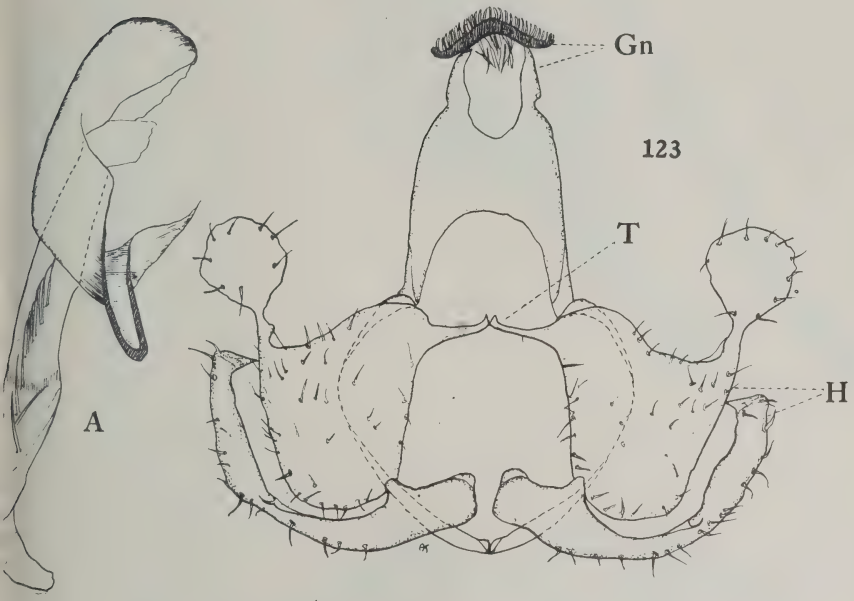
Family 15. **COLEOPHORIDÆ**

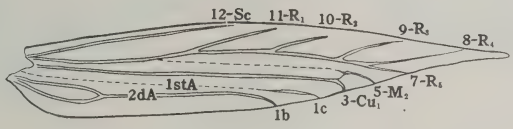
Carl Heinrich[16]

Head smooth. Antennæ $\frac{2}{3}$ to 1; thickened with scales toward base basal joint with appressed scales, rough scaled, or with projectin scale tuft. Labial palpi moderate or long; ascending. Maxillary palp absent. Posterior tibiæ rough haired above or smooth. Fore wing (fig. 124) elongate, narrow; never more than eleven veins; 1b (2d A furcate; 2 ($\mathbf{Cu}_2$) sometimes absent; 4 ($\mathbf{M}_3$) sometimes absent or unite with 3 ($\mathbf{Cu}_1$); 6 ($\mathbf{M}_1$) absent; 7 ($\mathbf{R}_5$) to termen; 7 and 8 ($\mathbf{R}_4$ and $\mathbf{R}_5$ approximate, connate, or stalked; pattern limited to irrorations o darker or lighter scales, longitudinal lines, or dustings, or one or mor stigmata; wings often unicolorous, never with transverse markings o fasciæ. Hind wings (figs. 124, 125) linear-lanceolate; narrower tha fore wings; 6 to 8 veins; crossveins between 5 and 6 ($\mathbf{M}_1$ and $\mathbf{M}_2$ weak or absent. 3 ($\mathbf{Cu}_1$) sometimes absent; 4 ($\mathbf{M}_3$) sometimes absent 5 and 6 ($\mathbf{M}_1$, $\mathbf{M}_2$) separate; 6 and 7 ($\mathbf{R}$, $\mathbf{M}_1$ closely approximate, con nate, or stalked. Male genitalia (fig. 123, A) with harpe partl divided; costal arm of harpe free for half its length, weakly chitin ized; arms of gnathos fusing and forming a complete ring about anu terminating in a more or less scobinate knob; gnathos occupyin place of, and apparently functioning as, an uncus; uncus absen Ædœagus rather stout, short or moderately long, hinged to vinculum.

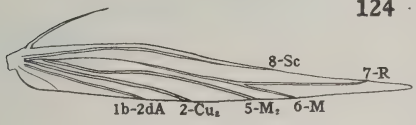
Larvæ inhabiting portable cases (figs. 126, 127, 127a, b) feeding o leaves, flowers, fruits, and seeds of various plants; external feede or miners; never boring into stems of plants or folding or rollin leaves; with 3 setæ on prespiracular shield of prothorax. II caud laterad of I on abdominal segments 1 to 8, IV and V approximate o abdominal segments 3 to 8; prothoracic spiracle vertically placed.

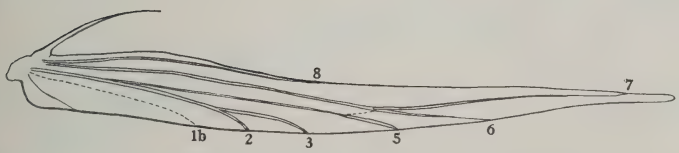
[16] Of the Bureau of Entomology, United States Department of Agriculture.





124





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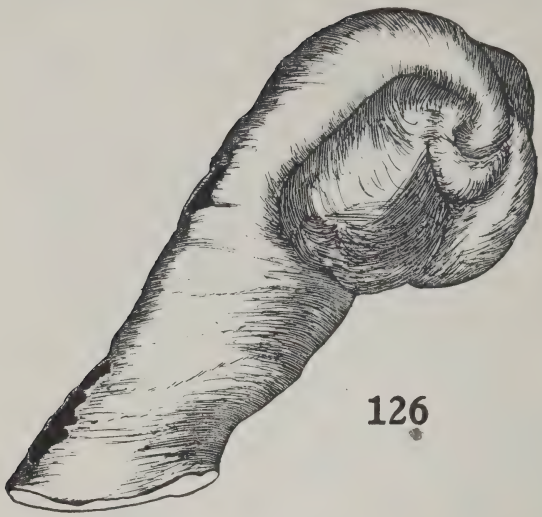
FIGS. 123–125. COLEOPHORIDÆ

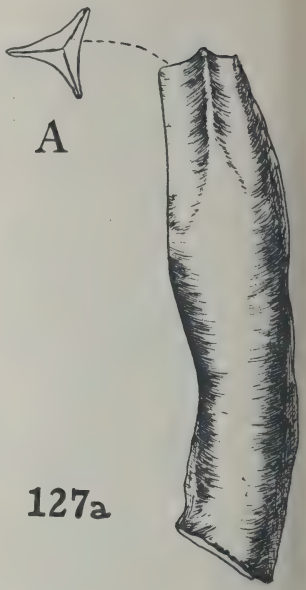
123, Male genitalia of *Coleophora atlantica* Heinrich: **H**, harpe; **Gn**, gnathos; **T**, transtilla; **A**, Aedœagus and penis (lateral view)

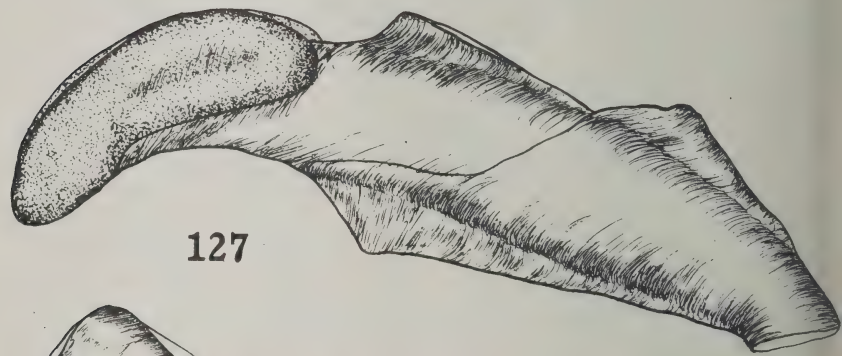
124, Venation, fore and hind wings of *Coleophora laricella* Hübner

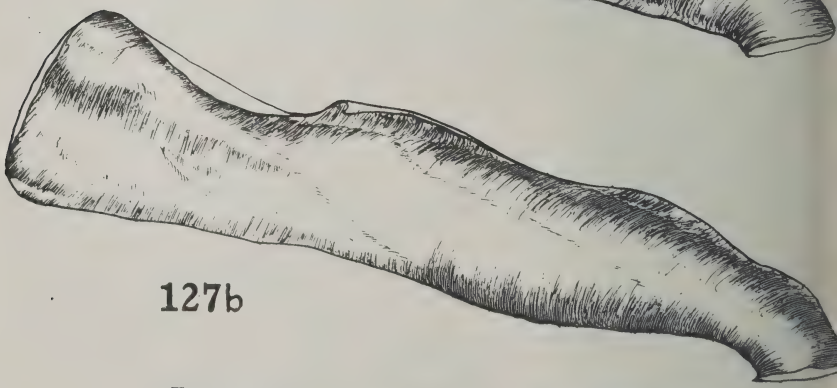
125, Venation of hind wing of *Coleophora vernoniœella* Chambers

(Drawn by Ada F. Kneale, of the Bureau of Entomology of the United States Department of Agriculture)









FIGS. 126–127b. COLEOPHORIDÆ: LARVAL CASES

126, Larval case of *Coleophora atlantica* Heinrich (typical "pistol case")
127, Larval case of *Coleophora leucochrysella* Clemens
127a, Larval case of *Coleophora fletcherella* Fernald: A, triangular compression of posterior end
127b, Larval case of *Coleophora laticornella* Clemens (typical "cigar case")
(Drawn by Ada F. Kneale, of the Bureau of Entomology of the United States Department of Agriculture)

The family as here characterized includes, besides the typical *Coleophora* Hübner, two other small European genera, *Goniodoma* Zeller and *Metriotes* Hübner (*Asychna* Stainton). Of the exotic genera, which I have not seen, two of Meyrick's (the Australian *Corythangela* and the African *Platybathra*) should probably also be included. Venational and genital characters, namely the obsolescence of the fork in 1b **2d A**) of fore wing, the stalking or fusing of 5 and 6 ($\mathbf{M}_1$ and $\mathbf{M}_2$) n the hind wing, and the presence of both gnathos and a large functioning uncus, exclude *Batrachedra* Stainton which is usually associated with *Coleophora.*

In North America all our species belong to the genus *Coleophora* Hübner, which may be defined as follows:

1. *COLEOPHORA* Hübner

Antennæ ⅘; porrected in repose. Labial palpi smooth or with slight tuft on under side of second joint toward apex. Posterior tibiæ rough haired above; anterior spurs of hind tibiæ from beyond middle. Fore wing with 7 and 8 ($\mathbf{R}_4$ and $\mathbf{R}_5$) connate or stalked. Hind wing ⅔; 6 to 8 veins; 3 ($\mathbf{Cu}_1$) rarely absent; 4 sometimes absent; crossvein between 5 and 6 ($\mathbf{M}_1$ and $\mathbf{M}_2$) nearly obsolete.

Larva with head elongate ovoid, longer than wide; frons extending nearly to incision of dorsal hind margin; anterior and lateral setæ and punctures crowded forward on head, nearly in a straight line approximate to ocelli; ultra-posterior portion of epicranium large. Body setæ much reduced; thoracic tubercles enlarged, usually fusing on dorsum of meso- and metathorax to form secondary shields. Crochets uniordinal, in a flattened ellipse opening inwardly, or in two transverse bands; frequently reduced in number; sometimes altogether absent.

Pupa incomplete; with appendages soldered together, but not to body, extending nearly to or beyond caudal margin of body; caudal end of body with lateral extensions ending in sharp spines; femora of prothoracic legs defined; maxillary palpi absent; epicranial suture present; prothorax very short on meson, long on lateral margin, forming a double triangle; abdomen not spined above; cremaster absent. This description probably applies to the entire family, but inasmuch as only pupal representatives of *Coleophora* were seen, the description is given under the genus.)

Coleophora is a very large genus, numbering between four and five hundred described species, largely confined to the northern hemisphere, and reaching its greatest development in middle and southern Europe and the United States. A couple of species have been described from South America, several from South Africa and India, and a few from Eastern Asia. In the United States we have some ninety odd described species, of which over half are found in the region covered by this hand book. Several attempts have been made to divide this unwieldy genus, but so far all have failed. The following table and arrangement of species, while arbitrary, attempts to follow natural lines, as far as is consistent with convenience of identification, and to bring together related species. Group VIII appears to be a natural one and on purely larval characters and habits should have generic rank; but so far, no consistent adult characters have been found to separate it from other *Coleophora.* The antennal character given (projecting hair tufts on basal joint) holds for the described North American species; but in Europe is also found on some species outside the free feeding group.

For the student of Lepidoptera, this family offers a fascinating study. There are still many new life histories to be worked out and many species yet to be

described. The group as a whole, however, is such a difficult one and so many of the species are similar, that accurate determinations can be made only by one who has a large collection available and has had considerable experience with the group. As it is, even he can not always be sure of his species unless he has both larval case and food plant records as well as the adult. No one should think of describing new *Coleophora* except from bred specimens carefully determined. To describe from collected adult material alone is nothing short of a crime, as it can only add to the inconvenience and confusion of future workers.

Key to the species

1. Antenna with basal joint simple, rough scaled, or with only slight tuft, never with large projecting tuft; fore wing never pure white unmarked by longitudinal lines 2
   Antenna with large projecting tuft on basal joint; or, if tuft is absent or much reduced, fore wing snow white unmarked by longitudinal lines 42
2. Fore wing metallic or gray brown, unicolorous, sometimes tinged with ochreous or darker shades at apex but never striped or otherwise marked 3
   Fore wing otherwise 12
3. Fore wing dark gray to grayish brown, semi-lustrous 4
   Fore wing with shining, irridescent, metallic luster 10
4. Apex of fore wing distinctly tinged with grayish ochreous (1) *cerasivorella*. (2) *zelleriella*.
   Apex of fore wing not distinctly tinged with grayish ochreous 5
5. Head with decided ochreous tinge ..... (3) *occidentis*. (4) *fletcherella*.
   Head gray or grayish brown 6
6. Entire insect shining steel gray ..... (5) *laricella*.
   Entire insect gray-brown or drab 7
7. Fore wing somewhat paler than hind wing towards apex ..... (8) *concolorella*.
   Fore wing concolorous with, or somewhat darker than, hind wing towards apex 8
8. Legs and underside of moth with pale dustings grayish and largely obscured by dark scaling ..... (6) *unicolorella*.
   Legs and underside of moth with pale dustings white and conspicuously predominating over darker scaling 9
9. Fore and hind wing a uniform, dark, smoky gray-brown ..... (7) *pruniella*.
   Fore and hind wing rather pale gray-brown ..... (9) *cinerella*.
10. Antenna simple, thickened at base only ..... (10) *cænusella*.
    Antenna clothed with rough scales for ½ or more 11
11. Antenna with rough scaling to ½; annulated beyond ..... (11) *coruscipennella*.
    Antenna with rough scaling to ⅘; apical ⅕ silver white ..... (12) *apicialbella*.
12. Fore wing yellow to dark brown, more or less streaked with white 13
    Fore wing white streaked with yellowish white (or yellowish white streaked with white) 28
13. Fore wing golden to dark brown; costa white; otherwise unmarked 14
    Fore wing yellow unicolorous; or yellow with white costal and dorsal margins; or ochreous fuscous with the veins outlined in white; or brownish with two or more white stripes 22
14. Fore wing dull blackish brown 15
    Fore wing drab brown to golden brown 16
15. Antenna annulated ..... (13) *rosacella*.
    Antenna not annulated ..... (14) *albiantennœlla*.
16. Fore wing very dark (blackish brown) toward apex 17
    Fore wing nearly uniform golden brown, scarcely darker towards apex 18

17. Head and scaling on basal joint of antenna grayish ochreous with little admixture of white.....(15) *carpinella.*
Head and scaling on basal joint of antenna ochreous with considerable admixture of white.....(16) *umbratica.*
18. Dorsal cilia on fore wing dull grayish fuscous.....19
Dorsal cilia on fore wing ochreous fuscous.....20
19. Larval case smooth.....(17) *caryæfoliella.*
Larval case with a notch on upper edge near posterior end.....(18) *ostryæ.*
20. Alar expanse more than 10 mm.....(19) *limosipennella.*
Alar expanse less than 10 mm.....21
21. Larval case rough; mouth deflected to 90 degrees; posterior end flattened to a slightly curved edge.....(20) *corylifoliella.* (21) *alniella.*
Larval case smooth; mouth deflected to 45 degrees; posterior end flattened to a straight edge.....(22) *lentella.*
22. Ground color of fore wing yellow.....23
Ground color of fore wing brownish.....26
23. Costa of fore wing dark.....(23) *ochrella.*
Costa of fore wing pale.....24
24. Costal and dorsal margins of fore wing white.....25
Costal and dorsal margins of fore wing pale yellowish, fusing with ground color of wing.....(24) *gaylussaciella.*
25. Ground color of fore wing pale cream-yellow.....(25) *cretaticostella.*
Ground color of fore wing dark yellow.....(26) *kearfottella.*
26. Ground color of fore wing drab brown.....(27) *polemoniella.*
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27. Fore wing with two white longitudinal streaks.....(28) *astericola.*
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28. Fore wing with no fuscous or dark ochreous dustings on white areas.....29
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29. Alar expanse 10 mm. or over.....30
Alar expanse less than 10 mm.....(30) *quadrilineella.*
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32. White median shade along upper margin of cell sending only two branches to costa.....(32) *biforis.*
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33. Only three ochreous lines on fore wing.....(33) *coenosipennella.*
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34. Three ochreous lines above fold in fore wing distinctly separated by white lines.....(34) *cratipennella.*
Three ochreous lines above fold tending to fuse.....(35) *shaleriella.*
35. Antennæ distinctly annulated for basal half.....(36) *cæspititiella.*
Antennæ not distinctly annulated for basal half.....(37) *ericodes.*
36. Head and greater part of fore wing pure white; dark dustings limited to a few scattered scales toward apex.....37
Head and greater part of fore wing ochreous.....39
37. Outer margin of fore wing mostly white.....(38) *veroniœella.*
Outer margin of fore wing ochreous.....38
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Hind tarsi not annulated with fuscous.....(40) *granifera.*

39. Head whitish ochreous; white on fore wing distinct.....40
Head dark grayish ochreous; white on fore wing almost completely obscured by ochreous or fuscous scaling.....41
40. Fuscous dustings on white areas of fore wing slight, not forming conspicuous spots or dashes.....(41) *fagicosticella.*
Fuscous dustings pronounced on white areas, crowded to form a blackish-brown dash at end of cell.....(42) *amaranthella.*
41. Antennæ distinctly annulated.....(43) *vagans.*
Antennæ not distinctly annulated.....(44) *lapidicornis.*
42. Antenna simple or white; only slight basal tuft.....43
Basal tuft on antenna well developed.....44
43. Fore wing pure white, unmarked.....(45) *argentialbella.*
Fore wing pure white except apex which is strongly tinged with pale golden yellow.....(46) *leucochrysella.*
44. Fore wing white at least at base.....45
Fore wing without any white; ochreous at base.....47
45. White on fore wing limited to basal half of wing.....46
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Cilia of fore wing and hind wing dark smoky fuscous, concolorous with darkest parts of wings.....(49) *tiliæfoliella.*
48. Head, thorax, and antennal tuft pure white.....(50) *rosæfoliella.*
Head, thorax, and antennal tuft white sprinkled with grayish fuscous. (51) *malivorella.*
49. Fore wing faintly striped and dusted toward apex with ochreous and fuscous. (52) *atromarginata.*
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50. Dark dustings abundant and well scattered over fore wing....(53) *elæagnisella.*
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51. Apex of fore wing lightly dusted with blackish fuscous scales..(54) *querciella.*
Apex of fore wing lightly dusted with ochreous or golden scales..(55) *atlantica.*

I. *Moths with fore wings gray-brown, unicolorous, sometimes tinged with ochreous or darker shades but not striped or otherwise marked. Larval cases with posterior ends flatly or triangularly compressed. Larvæ leaf-miners or seed feeders.*

(1) **C. cerasivorella** Packard.

Alar expanse: 9–9.5 mm.
Localities: Massachusetts; Wisconsin. (June).
Food plants: Cherry; apple.
Larval case: Unknown.

Moths in the United States National Museum are without the larval case. They were reared from apple in Bellingham, Wisconsin. Packard reared the moths from larvæ taken feeding on leaves of cherry, at Salem, Massachusetts, but he gives no description of the larval case.

(2) **C. zelleriella** Chambers.

Alar expanse: 9 mm.
Locality: Kentucky.
Food plant: Unknown.
Larval case: Ochreous; slender; cylindrical; tapering slightly to each end; posterior end triangularly compressed; 12 mm. long (From Chambers' description).

This species is known only from Chambers' meager description. It is probably a synonym of *cerasivorella* Packard.

(3) **C. occidentis** Zeller.

Alar expanse: 10 mm.
Locality: Massachusetts.
Food plant: *Prunus serotina.*
Larval case: Brown, cylindrical; upper edge serrate; mouth deflected to 45 degrees; posterior end triangularly compressed.

This species is known only from Zeller's description. It is placed in our specific key with *fletcherella* only tentatively. If the two are one species, as is quite possible, Zeller's name will take precedence over the better known *fletcherella.* In our lists *occidentis* is wrongly listed as a synonym of *pruniella* Clemens.

(4) **C. fletcherella** Fernald.

Alar expanse: 10–12 mm.
Locality: Northern United States and Canada (June).
Food plants: Apple, pear, cherry, hawthorn.
Larval case (fig. 127a): Brown; cylindrical; smooth; mouth deflected from 45 degrees to 60 degrees; posterior end triangularly compressed; 7–8 mm. long.

This is the economically important "cigar case-bearer" on apple, and is easily distinguished from other gray-brown, unicolorous species by its yellowish head. It is probably a synonym of *occidentis* Zeller, but this can only be decided by further and more extensive rearings. Zeller describes the larval case of *occidentis* as serrate above. All cases of *fletcherella* in the United States National Museum have the upper edge smooth.

(5) **C. laricella** Hübner. (Fig. 124).

Alar expanse: 9–10 mm.
Locality: northeastern United States.
Food plant: Larch.
Larval case: Gray, with a yellowish or brownish patch on the outer side extending from the mouth and formed by a part of the leaf fiber woven into the case; mouth deflected from 45 degrees to 60 degrees; posterior end triangularly compressed; 5 mm. long.

This species is commonly known as the "larch case-bearer," and often does considerable damage to the trees.

(6) **C. unicolorella** Chambers.

Alar expanse: 8–9 mm.
Locality: Eastern United States (June).
Food plant: Seeds of *Juncus.*
Larval case: Dirty gray, ornamented with many small frass pellets; stout; cylindrical; mouth deflected to 90 degrees; posterior end broad, pyramidal, triangularly compressed; 4.5–5 mm. long.

(7) **C. pruniella** Clemens.

Alar expanse: 12.5–13 mm.
Localities: Pennsylvania; Ohio. (June).
Food plant: *Prunus serotina.*
Larval case: A double affair, composed of a small curved, silken first case, inserted into a later one cut from the serrate edge of the mined leaf, thus resembling a pistol butt projecting from a holster (in the spring often losing the silken posterior part); mouth slightly deflected; posterior end rounded and flatly compressed; 5–6 mm. long.

(8) **C. concolorella** Clemens.
Alar expanse: 10 mm.
Locality: Pennsylvania (June).
Food plant: Unknown.
Larval case: Unknown.

A pale mauve species near *cinerella* Chambers but apparently distinct.

(9) **C. cinerella** Chambers.
Alar expanse: 10 mm.
Localities: Kentucky; District of Columbia. (End of May to July).
Food plants: Birch and alder.
Larval case: Similar to that of *pruniella* Clemens; dark rusty brown; roughly cylindrical with a couple of serrate projections on outer side; mouth deflected to 45 degrees; posterior end rounded and flatly compressed.

II. *Entire insect of a shining metallic luster; unicolorous, larval case with apex triangularly compressed. Larvæ leaf miners on low plants.*

(10) **C. aenusella** Chambers.
Alar expanse: 11 mm.
Locality: Kentucky.
Food plant: Unknown.
Larval case: Unknown.

Known only by Chambers' description. Easily recognized, however, being the only metallic bronzy species in the eastern United States with simple antenna thickened at basal joint only.

(11) **C. coruscipennella** Clemens.
Alar expanse: 11–12 mm.
Locality: United States (May–August).
Food plant: Unknown.
Larval case: Unknown.

A very common species, found nearly everywhere in the United States. Has been frequently identified as the European *spissicornis* Haw. (*fabriciella* Vill.). *C. auropurpurella* Chambers is a synonym.

(12) **C. apicialbella** Braun (*apicella* Braun).
Alar expanse: 9.5–11 mm.
Locality: Cincinnati, Ohio. (late May and early June).
Food plant: *Silene virginica.*
Larval case: Gray, darker on dorsal surface; cylindrical; mouth slightly deflected; 7–9 mm. long.

Easily distinguished from other species of this group by the antennæ. These are clothed with rough, purplish scales for basal four-fifths, the apical fifth being silvery white without annulations but with a black dot on underside of each segment.

III. *Moths with fore wings golden to dark brown; costa white, otherwise unmarked; antenna thickened with scales near base, with very slight tuft on basal joint. Larval cases cylindrical and with apices flatly compressed (The so-called "cigar-case" type fig. 127b). Larvæ leaf miners, mostly on trees and shrubs.*

(13) **C. rosacella** Clemens.
Alar expanse: 10.5 mm.
Locality: Pennsylvania (late May and early June).
Food plants: Rose and sweet briar.
Larval case: Brown; smooth except for one or more serrations on upper edge; mouth deflected (from Clemens' description).

The darkest of the brown Coleophoras with white costal markings on the fore wing.

(14) **C. albiantennaella** Wild.
Alar expanse: 12–13 mm.
Locality: Buffalo, New York (late July).
Food plant: *Cornus.*
Larval case: Gray-brown; smooth; upper edge not serrate; mouth deflected to 45 degrees; posterior end as broad as, or broader than, middle of case; 11 mm. long.

This species easily distinguished from others of this group by the lack of annulations on the antenna.

(15) **C. carpinella** Heinrich.
Alar expanse: 7–7.5 mm.
Locality: Maryland (June-July).
Food plant: *Carpinus caroliniana.*
Larval case: Yellowish brown; slender; smooth; mouth deflected to 45 degrees; posterior end as wide as middle of case, flattened to a straight edge; 6–7 mm. long.

(16) **C. umbratica** Braun.
Alar expanse: 8–9 mm.
Localities: Ohio; Virginia (middle to end of June).
Food plant: *Prunus americana.*
Larval case: Brown; rather slender; smooth except upper edge which is strongly serrate; mouth deflected from 45 degrees to 60 degrees; posterior end as wide as middle of case, flattened to a straight edge; 5–6 mm. long.

This species and *carpinella* are superficially very close. They may be distinguished from each other by the characters given in the table, the larval cases, and the food plants; and from the other golden brown species of this group (*caryaefoliella* and allies), by the distinctly darker shading of the fore wing towards the apex.

(17) **C. caryæfoliella** Clemens.
Alar expanse: 9–10 mm.
Locality: Eastern United States (May-June in the South; June-July in the North).
Food plants: Hickory and pecan.
Larval case: Brown; smooth; without serration on upper edge; mouth deflected to 45 degrees; posterior end as wide as middle of case, flattened to a straight edge; 6–6.5 mm. long.

This very common species is found nearly everywhere that its food plants occur. It is a rather important enemy of the hickory in the north and of the pecan in the south. In economic literature it is referred to as the "hickory cigar case-bearer" or the "pecan cigar case-bearer." In spite of its importance, comparatively little is known about it, and it should be more intensively studied. There is quite possibly more than one species attacking the hickory, which would account for the wide range of variation in the specimens now included under this name.

(18) **C. ostryæ** Clemens.
Alar expanse: 7.5–8 mm.
Localities: Pennsylvania; Ohio (June).
Food plant: *Ostrya virginica.*
Larval case: Pale reddish brown; rather wide; smooth except for upper edge which normally has a slight notch near posterior end; mouth slightly deflected; posterior end as wide as middle of case, flattened to a straight edge.

Miss Braun states that she has also reared this species from hickory and considers it a synonym of *caryaefoliella* Clemens. Until the latter is better known, however, it would seem better to retain the two as separate species.

(19) **C. limosipennella** Duponchel (*laticornella* Clemens).
Alar expanse: 10.5–12.5 mm.
Locality: Northeastern United States (June-July).
Food plant: Elm.
Larval case: (fig. 127b): Brown; rather broad; smooth except for uppe edge which is more or less serrate and slightly sinuate mouth deflected to 60 degrees; posterior end a trifle wide than middle of case, flattened to a slightly curved edge 10–11 mm. long.

Locally important in this country as a pest of the elm. In Europe als recorded from alder and birch.

(20) **C. corylifoliella** Clemens.
Alar expanse: 8–9 mm.
Localities: Pennsylvania; Maryland; Virginia (June-July).
Food plant: *Corylus americana.*
Larval case: Dark brown; rather broad; rough and fibrous; upper edg serrate; mouth deflected to 90 degrees; posterior en narrower than middle of case, flattened to a slightly curve edge; 6–6.5 mm. long.

(21) **C. alniella** Heinrich.
Alar expanse: 8–9 mm.
Localities: Maryland; Virginia (June and early July).
Food plant: *Alnus.*
Larval case: As in *corylifoliella* Clemens.

The only appreciable difference between reared specimens of this species an *coryifoliella* is in the somewhat darker and more distinctly marked brown annula tions on the antenna of the latter. It is quite probable that it will eventuall prove to be a synonym of Clemens' species.

(22) **C. lentella** Heinrich.
Alar expanse: 8 mm.
Locality: Long Island, New York (June).
Food plant: *Betula lenta.*
Larval case: Gray brown; broad, smooth except for upper edge which i markedly serrate; mouth deflected to 45 degrees; posterio end narrower than middle of case, flattened to a straigh edge; 4.5–5 mm. long.

IV. *Moths with fore wings yellow, unicolorous or golden yellow, more or les striped with white; not dusted or spotted. Antennæ with basal joints thickene or slightly tufted. Larval cases with posterior ends flatly compressed.*

(23) **C. ochrella** Chambers.
Alar expanse: 12 mm.
Locality: Kentucky (June).
Food plant: Unknown.
Larval case: Unknown.

A dull dark yellow, unicolorous species with basal third of costa a trifle darke than ground color of fore wing. The only described species of this kind fro North America.

(24) **C. gaylussaciella** Heinrich.
Alar expanse: 10 mm.
Locality: Falls Church, Virginia (June).
Food plant: *Gaylussacia baccata.*
Larval case: Brown; cylindrical; widest just beyond middle; tapering slightly to both ends; mouth deflected to 90 degrees; posterior end rounded; 6–6.5 mm. long.

Close to *cretaticostella* Clemens but distinguished by characters given in the table.

(25) **C. cretaticostella** Clemens.
Alar expanse: 12.5 mm.
Localities: Pennsylvania; Canada; Ohio; Massachusetts; Maryland; (May, June).
Food plant: Blackberry.
Larval case: Dark brown; of the *pruniella* type; composed of silk and leaf; slightly irregular in outline but not appreciably curved; posterior end rather abruptly tapering; mouth deflected to 45 degrees; 7–7.5 mm. long.

A very pretty species distinguished by the white costal and dorsal margins and basal part of fore wing.

(26) **C. kearfottella** Barnes and Busck.
Alar expanse: 11–12 mm.
Locality: Essex County, New Jersey.
Food plant: *Salix.*
Larval case: Formed of silk and bud scales; very irregular; as broad as long; mouth slightly deflected; 5–6 mm. long.

Close to *cretaticostella* Clemens but distinguished by the much darker yellow ground color of the fore wings.

V. *Moths with fore wings dark grayish brown or drab, faintly striped with white. Antennæ with basal joints thickened but not appreciably tufted. Larval cases flatly or triangularly compressed.*

(27) **C. polemoniella** Braun.
Alar expanse: 13–14 mm.
Locality: Cincinnati, Ohio (May and early June).
Food plant: *Polemonium reptans.*
Larval case: White with a grayish patch on dorsal surface adjacent to mouth; rather slender, cylindrical; mouth deflected to 45 degrees; posterior end flatly compressed and flaring, considerably broader than middle of case; 9–10 mm. long.

An easily recognized species. In some specimens the white markings nearly obsolete except on costa.

(28) **C. astericola** Heinrich.
Alar expanse: 13 mm.
Locality: Boston, Massachusetts (September).
Food plant: *Aster multiflorus.*
Larval case: Grayish white; slender; cylindrical; mouth deflected to 45 degrees; posterior end rounded and flatly compressed, narrower than middle of case; 13 mm. long.

(29) **C. infuscatella** Clemens.
Alar expanse: 11 mm.
Locality: Pennsylvania.
Food plant: Unknown.
Larval case: Unknown.

VI. *Moths with fore wings white, longitudinally streaked with yellowish white or whitish-yellow streaked with white, with or without fuscous or ochreous dustings on white areas. Antennæ with basal joints thickened but never appreciably tufted. Larval cases with posterior ends triangularly compressed. Larvæ seed feeders or leaf miners on low plants.*

(30) **C. quadrilineella** Chambers.
Alar expanse: 7 mm.
Locality: Eastern United States (June through August).
Food plant: Seeds of *Juncus.*

Larval case: Gray; covered with particles of frass on posterior fourth along upper anterior portion of three-fourths of its lengt a shining shield formed from part of the seed capsul of the food plant; cylindrical; slender; mouth deflecte to 90 degrees; 4–4.8 mm. long.

(31) **C. borea** Braun.
Alar expanse: 15–16 mm.
Locality: Cincinnati, Ohio.
Food plant: *Polygonum scandens.*
Larval case: Blackish brown; stout; cylindrical; mouth slightly deflected 8–9 mm. long (From Miss Braun's description).

(32) **C. biforis** Braun.
Alar expanse: 11.5–12.5 mm.
Locality: Cincinnati, Ohio.
Food plant: *Luzula campestris.*
Larval case: "slender, cylindrical, tapering to the three-valved apex. Th sides of the obtuse apical angles of the valves are ver short; from the point of union of adjacent valves, gradually lowering ridge runs about halfway down th case"; 8–8.5 mm. long. (From Miss Braun's description

(33) **C. coenosipennella** Clemens.
Alar expanse: 11.5–12 mm.
Locality: Eastern United States.
Food plant: *Stellaria pubera.*
Larval case: Grayish; "decorated with numerous dark reddish granules; cylindrical; mouth strongly deflected; 6 mm. long.

(34) **C. cratipennella** Clemens.
Alar expanse: 14.5 mm.
Locality: Eastern United States (May and early June).
Food plant: Seeds of *Juncus.*
Larval case: Grayish ochreous, shading to reddish brown at apex; cylin drical; smooth; unornamented; mouth deflected to 4 degrees; 8 mm. long.

(35) **C. shaleriella** Chambers.
Alar expanse: 13.5–15 mm.
Localities: Kentucky; Ohio (August to September).
Food plant: Seeds of *Polygonum punctatum.*
Larval case: Pale straw color; elongate; slender; tapering gradually t pointed apex; decorated from mouth with four or fiv narrow strips of leaf extending backward four-fifths th length of the case, and by seven or eight distinct lines o frass extending backward about ¼; 10–11 mm. long.

(36) **C. caespititiella** Zeller.
Alar expanse: 11–12 mm.
Localities: Maryland; Virginia (May–June).
Food plant: Seeds of *Juncus.*
Larval case: Pale straw color to pale gray brown; cylindrical; smooth undecorated; mouth deflected to 45 degrees; 6–6.5 mm. lon

(37) **C. ericodes** Braun.
Alar expanse: 12 mm.
Locality: Cincinnati, Ohio (September).
Food plant: Seeds of *Aster ericodes.*
Larval case: Pale straw color to ashy brown; rather densely covered wit pappus from flowers of food plant which extend beyon the apex; mouth deflected; 4.5–5 mm. long.

(38) **C. vernoniælla** Chambers (fig. 125) (*veroniœella* of Dyar's list).
Alar expanse: 11–13.5 mm.
Localities: Kentucky; Missouri; Ohio; Virginia (late June to mid-July).
Food plants: *Vernonia, Helianthus.*
Larval case: Dark gray brown; slender elongate; tapering; needle-like; mouth deflected from 20 degrees to 45 degrees; 13–20 mm. long.

(39) **C. duplicis** Braun.
Alar expanse: 11.5–14.5 mm.
Localities: Ohio; North Carolina.
Food plants: *Aster shortii, Aster cordifolina, Solidago cœsia, S. latifolia.*
Larval case: Irregular, formed from bits of seeds and flowers attached to a cylinder of silk; mouth deflected.

(40) **C. granifera** Braun.
Alar expanse: 12.5–14 mm.
Locality: Cincinnati, Ohio (June–July).
Food plant: Leaves of *Aster shortii.*
Larval case: Brownish red, paler towards apex, with a dark brown, granular spot on upper side near mouth; cylindrical; mouth slightly deflected; 10 mm. long.

(41) **C. fagicosticella** Chambers (synonym, *C. lineapulvella* Chambers).
Alar expanse: 8–10 mm.
Locality: Eastern United States (end of May, through June).
Food plant: Seeds of *Juncus.*
Larval case: Composed of silk and entire seed pod of food plant, bractlets forming an outer scalloped enveloped for silk portion of case protruding beyond; mouth deflected to 90 degrees; 5 mm. long.

A very common species.

(42) **C. amaranthella** Braun.
Alar expanse: 12–14 mm.
Localities: Kentucky; Ohio (late July–August).
Food plant: Seeds of *Amaranthus hybridus.*
Larval case: Brownish, decorated with numerous, small, buff-gray particles; mouth deflected; apex pyramidal. 6 mm. long

(43) **C. vagans** Walsingham.
Alar expanse: 12 mm.
Locality: New York City (August).
Food plant: Grass.
Larval case: Stone gray with brown patch on upper side near mouth (similar to *quadrilineella* Chambers); cylindrical, slightly bulged in center; mouth deflected to 90 degrees; 7–7.5 mm. long.

Distinguished from other grass- and Juncus-feeding species by the heavy fuscous dustings nearly obscuring the whitish lines on fore wing.

(44) **C. lapidicornis** Walsingham.
Alar expanse: 11.5 mm.
Locality: Ohio (August).
Food plant: Peach.
Larval case: Dark, dusty gray brown; smooth; cylindrical; rather stout; scarcely tapering; mouth deflected to 90 degrees; 7 mm. long.

VII. *Moths with fore wings white, unmarked, or shading to yellowish towar apex, not longitudinally striped or spotted; antennæ simple or with slight tuft. Larval cases formed of silk and leaf; posterior ends flatly compressed. Larvæ lea miners in trees and shrubs.*

(45) **C. argentialbella** Chambers.
Alar expanse: 10–11 mm.
Locality: Kentucky.
Food plant: Unknown.
Larval case: "Long and slender" (Chambers). Easily recognized, bein the only pure white species with simple antenna describe from the eastern United States.

(46) **C leucochrysella** Clemens
Alar expanse: 14–15 mm.
Locality: Eastern United States (June).
Food plant: *Castanea dentata.*
Larval case (fig. 127): Irregular; of the *pruniella* type, with silken firs case inserted in later one cut from mined portion of leaf silken part grayish tinged with black; leaf part yellow o brownish; mouth deflected to 45 degrees; posterior en curved; 10–11 mm. long.
An easily recognized species; fairly common wherever its food plant grows.

(47) **C. viburnella** Clemens.
Alar expanse: 11.5 mm.
Localities: Pennsylvania; Ohio (end of May).
Food plant: *Viburnum prunifolium.*
Larval case: Of the *pruniella* type; upper edge with flattened, serrate, wing like projection rising about 2.5 mm. above the barrel o the case; reddish brown; mouth deflected; posterior en slightly curved; 10 mm. long.
The basal joint of the antenna is somewhat more tufted than that of the othe species in this group. The moth, however, is easily recognized by the character given in the table.

VIII. *Moths with large projecting tuft on basal joint of antenna. Larval case of the "pistol" type* (fig. 126), *made of silk and frass; posterior ends never trian gularly compresssed.. Larvæ external feeders on leaves or flowers of trees an shrubs; never miners.*

(48) **C. nigralineella** Chambers.
Alar expanse: 12–13 mm.
Locality: Kentucky (July).
Food plant: Unknown. Larval case found attached to stem of *Juglan nigra.*
Larval case: Yellow; pistol handle brown on upper side, white underneath on upper side, near mouth, a small triangular projectio used for attachment of case during pupation (from Cham bers' description).

(49) **C. tiliæfoliella** Clemens.
Alar expanse: 14–14.5 mm.
Localities: Pennsylvania; New York; Ontario, Canada (June–July).
Food plant: Tilia (basswood).
Larval case: Uniform black; pistol handle turned down abruptly (at right angle with upper edge); small toothed projections about middle of under edge; upper edge straight; flaps present small, appressed; mouth deflected to 45 degrees; 6.5–7 mm long.

(50) **C. rosæfoliella** Clemens.
Alar expanse: 12.5 mm.
Locality: Pennsylvania (end of May).
Food plant: Buds of common hundred-leaf rose.
Larval case: Of silk, covered with granulations; brown varied with gray; posterior end (pistol handle) turned down like a hook; mouth slightly deflected (from Clemens' description).

I have never seen the case, and the species is therefore only tentatively placed in this group. (C. H.)

(51) **C. malivorella** Riley.
Alar expanse: 12.5–14 mm.
Locality: Atlantic States (early July).
Food plant: Apple.
Larval case: Black with large, whitish fibrous patch along upper edge; handle short and evenly rounded; small, toothed projection on underside close to handle; flaps present, scalloped, small, and closely appressed within angle of handle; mouth deflected to 45 degrees; 8–9 mm. long.

This is the well-known "pistol case-bearer" on apple. The larvæ eat the buds, leaves, and young fruit.

(52) **C. atromarginata** Braun (*currucipennella* Walsingham nec Zeller).
Alar expanse: 10.5–14.5 mm.
Locality: Eastern United States (June–August).
Food plants: *Quercus platanoides* and *Quercus rubra.*
Larval case: Black, with faint white V marking on underside of barrel; handle turned down abruptly; flaps present, moderately large, not closely appressed; mouth deflected to nearly 45 degrees; 5.5–8 mm. long.

(53) **C. elæagnisella** Kearfott.
Alar expanse: 15–21 mm.
Locality: Ottawa, Canada (July).
Food plants: *Elæagnus argentea; Hippophoe rhamoides; Shepherdia argentea.*
Larval case: Grayish brown; elongate; without flaps; pistol handle reduced, giving a sort of scimitar shape to the case; upper edge smooth; a slight projection from near middle of lower edge; mouth deflected to 45 degrees; 10–12 mm. long.

(54) **C. querciella** Clemens.
Alar expanse: 12 mm.
Localities: Pennsylvania; Virginia; Long Island, New York. (June).
Food plants: *Quercus prinus* and *Q. alba.*
Larval case: Grayish, with conspicuous black, somewhat lumped patch on back near posterior end; without flaps; handle much reduced, turned down at 45 degrees angle with upper edge; a slight projection back of middle on lower edge; mouth deflected to 45 degrees; 9–10 mm. long.

(55) **C. atlantica** Heinrich (fig. 123).
Alar expanse: 11–15 mm.
Locality: Eastern United States.
Food plant: *Prunus serotina.*
Larval case (fig. 126): Black; handle evenly curved; flaps present, rather small and appressed; mouth deflected to about 45 degrees; 8–9 mm. long.

This is the pistol case species wrongly identified by Kearfott as *C. pruniella* and so listed in the New Jersey list.

SUPERFAMILY **CYCNODIOIDEA**

(Tineina, in part)

The Cycnodioidea are a small group, composed of isolated remnants of a primitive type which appears to have preserved $\mathbf{R}_{2+3}$ in the hind wings, as an independent vein. In the African genus Cycnodia, (fig. 128) the vein is fully preserved, as well as all the normal veins of the wing; in Aphelosetia, which is otherwise extremely close to Cycnodia, it appears to be lost; in Tinagma (fig. 131) it is preserved, but several dorsal veins are lost; while in the Heliozelidæ the venation is so reduced that the point cannot be settled. A distinctive character of these reduced forms, not so well shown in Cycnodia, is the unusually wide space between **Sc** and **R**, so that **R** forms the axis of the wing, instead of **M**, which takes that place in some other narrow-winged forms.

Head smooth; first joint of antennæ quite small; palpi moderate and slightly upturned or small, not bristled; maxillary palpi minute; hind tibiæ hairy. Fore wing with $\mathbf{R}_5$ running to costa when recognizable, but generally lost; with some dorsal veins usually lost also. Venation extremely reduced in *Coptodisca*. **1st A** free, **2d A** usually simple, but forked in Tinagma and some Aphelosetias. Hind wing narrower than fore wing; **Sc** and **R** strong, $\mathbf{R}_1$ usually not developed, but when present located close to base of wing; stem of **R** running nearly through axis of wing, in the narrow-winged forms with the outer veins branching from it. Male genitalia complex and characteristic.

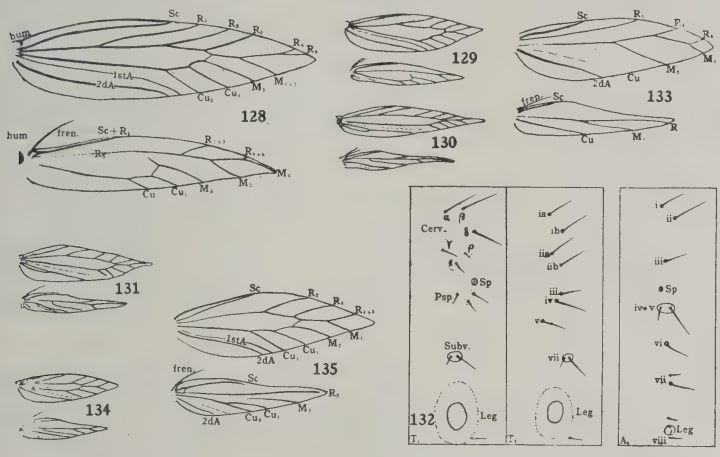
Eggs of flat type as far as known; larvæ leaf-miners, at least when young — the Heliozelidæ making a flat case before pupation exactly as in many Adelidæ. Pupæ various, never obtect.

Family 16. **CYCNODIIDÆ**

(Elachistidæ)

Head smooth or slightly ruffled on vertex; palpi slender and smoothly scaled, somewhat upturned or porrect, often strongly divergent, third segment well-developed; no ocelli; no maxillary palpi. Antenna with scape small, with pecten, shaft scaled more or less roughly all around, with two equal whorls to a segment. Tongue weak, scaled at base. Eyes small. Fore wing broad-lanceolate, the cell located in the middle, and cut off obliquely at its outer end (fig. 129) $\mathbf{R}_1$ arising from **R**-stem at middle of cell, $\mathbf{R}_4$ and $\mathbf{R}_5$ stalked or united, $\mathbf{M}_1$ stalked with them, sometimes with $\mathbf{R}_5$ beyond the point of separation of $\mathbf{R}_4$, $\mathbf{R}_3$ sometimes

lso stalked; $\mathbf{M}_3$ and $\mathbf{Cu}_1$ completely united, sometimes lost (*A. praenaturella*). Hind wing narrower, lanceolate, with $\mathbf{R}_1$ strong, but



FIGS. 128–135. CYCNODIIDÆ, DOUGLASIIDÆ, AND HELIOZELIDÆ

128, *Cyenodia cygnipennella* (North Africa), venation; **129,** *Aphelosetia argenella* (Europe), venation; **130,** *Douglasia ocnerostomella* (Europe), venation; **131,** *Timagma dryadis* (Europe), venation; **132,** *Douglasia balteolella* (Europe), venation; seta map of larva; **133,** *Coptodisca* species (on grape), venation; **134,** *Antispila treitschkiella* (Europe), venation; **135,** *Heliozela stannella* (Europe), venation (after Spuler)

crowded to extreme base of wing; **Sc** and $\mathbf{R}_s$ widely separated, **Sc** in Aphelosetia ending at middle of costa; $\mathbf{R}_{2+3}$ lost in Aphelosetia, present as a short spur in Cycnodia; $\mathbf{R}_{4+5}$ running to costa near apex, $\mathbf{M}_1$ (in our species) stalked with it; $\mathbf{M}_2$ lost in Aphelosetia; $\mathbf{M}_3$ associated with **Cu**-stem, the cell usually weakly closed. Anal region reduced.

This description is based on Aphelosetia, the only genus in eastern North America; in Cycnodia all the veins are present, and $\mathbf{R}_s$ of the hind wing is less widely separated from **Sc**. Superficially the moths are like Cosmopterygidæ; but can be distinguished by the radically different hind wing; the moderately long, divergent palpi are also rare in the Cosmopterygidæ.

The larvæ of Aphelosetia are leaf-miners on various grasses and sedges; they are flattened, with normal mouth-parts and sixteen legs. The mines vary in character, and the frass, unlike that of Cosmopteryx, is left in the mine. The pupa is formed exposed or in a mesh-work cocoon, and is attached by a band around the middle. In several species there are three longitudinal raised dark stripes. All its parts are fused,

the antennæ nearly as long as the wings, not separated by the legs or tongue; labial palpi covered and maxillary palpi absent. The head sclerites are of gelechiid type; cremaster without spines or hooks; and frontoclypeal suture absent. The body is roughened with rounded tubercles.

APHELOSETIA Stephens

(*Elachista* Treitschke, in part; *Cosmiotes* Clemens; *Eurynome* Chambers, not Leach; *Busckia* Dyar, *Phigalia* Chambers, not Duponchel; *Aphigalia* Dyar)

The characters are given in the description of the family. There is some variation in structure, especially in venation, but it is not large, and as there is some confusion in names no attempt is made here to divide the genus. *Elachista concolorella* Chambers is an *Eriphia*, but is not the *Eriphia concolorella* described by him on the same page. *E. orichalcella*, Dr. Braun informs me, is also a Cosmopterygid.

Key to the species (Braun)

1. White. ..... 1. *orestella.*
1. Ground color dark brown or gray, with white or silvery spots and fasciæ.
2. A white streak along base of costa ..... 2. *brachyelytrifoliella.*
2. A white, silvery, or leaden-metallic basal patch.
3. Veins Cu_2, M_3+Cu_1, and M_2 arising opposite the space between R_2 and R_3 in fore wing.
4. A silvery spot at tip of wing membrane.
5. Antennæ black throughout in both sexes ..... 3. *enitescens.*
5. Antennæ silvery white at tip ..... 4. *madarella.*
4. Costal streak at two-thirds way to apex, curving outward in middle of wing to tip of membrane ..... 5. *argentosa.*
3. Vein Cu_2 arising proximad of origin of R_2.
4. Apical fringe white ..... 6. *prælineata.*
4. Apical fringe dark brown or gray.
5. Head entirely white.
6. Fascia not reaching dorsal margin ..... 7. *cucullata.*
6. Fascia complete ..... 8. *albicapitella.*
5. Head not white, or at most with a white patch on face.
6. Head silvery gray, apex of antennæ white ..... 9. *sylvestris.*
6. A white patch on face, antennæ fuscous, annulate .. 10. *leucofrons.*
2. No white or metallic patch at base of fore wing.
3. Scales at extreme apex of wing white ..... 11. *præmaturella.*
3. No apical white spot.
4. A silvery costal streak in fringe beyond the pair of costal and dorsal streaks ..... 12. *illectella.*
4. A costal streak only, beyond the fascia ..... 13. *maculosella.*
4. Fascia followed by a costal and an opposite dorsal streak; no other markings.
5. Fascia and streaks metallic white ..... 14. *unifasciella.*
5. Fascia and streaks dull white ..... 15. *irrorata.*

1. **A. orestella** Busck. White, slightly yellowish; antennæ smoky on outer half, fore wing with a slight yellow tinge in fold, with black dots at middle of wing and at end of cell; abdomen and legs somewhat smoky. 11 mm.

Larva grayish or green, with two more or less prominent dark dorsal stripes on prothorax, ending behind in a pair of spots. Mine on Hystrix, beneath the

pper epidermis (which is turned down by a twist in the leaf), 3 or 4 cm. long, ray for the most part, but with a wrinkled central stripe which remains green. arva wintering in the mine, sometimes moving to a new leaf in the spring. upa in a very slight cocoon, stout, ovate, with four rather prominent mesothoracic ubercles; smooth and shining. Moth in May to July and September.
New York to Ohio. New York: Peru, Perry, Ithaca.

2. **A. brachyelytrifoliella** Clemens. Dark grayish brown, apical half of fore ing black-brown, base light; oblique white streaks from costa a third way, and vo-thirds way out, the second almost reaching one which rises up from the orsal margin. A white stripe along base of costa, joining the first transverse reak; two white streaks edged with black in costal fringe; a black apical spot, nd a white dot in dorsal fringe. Head in front, and palpi, silver white. 6 mm.
Larva mining a grass, *Brachyelytrum aristatum*, early in July; mine at first near, then a blotch taking up most of the leaf. Pupa external, on a slight eb. Imago emerging in late July.
Easton, Pennsylvania.

3. **A. enitescens** Braun. Head and thorax metallic-leaden, the head nearly black; ntennæ grayish black throughout; rest of fore wing dark brown. A silvery or olden fascia a third way out, oblique inward on costal half, broader and erect n dorsal half; two spots opposite each other at two-thirds, and a spot at apex f membrane; base of inner margin sometimes with silvery or golden scales. etallic markings with some reddish or purple luster. Fringes and upper side f abdomen dark gray; hind wing dark brown. 7–7½ mm.
Larva on *Scirpus atrovirens* (bulrush), forming a long transparent mine in a asal leaf, extending from the base upward; wintering in the mine, and moving o a second leaf after some feeding in the spring. Larva yellow with a pair f ill-defined dark patches on posterior part of prothorax; Pupa in a light flat coon of rhomboidal meshes. Pupa stout, with dorsum of abdomen flattened, and ith a subdorsal series of short blunt spines; thorax with three or four prom- ent lateral tubercles. Moths in May and early June.
The larva feeds only at night, retiring by day to the base of the leaf, some- mes beneath the water level.
Cincinnati, Ohio.

4. **A. madarella** Clemens. Similar to *A. enitescens;* head paler, tips of antennæ hite, base of fore wing more golden and legs paler. 8 mm. (*Cosmiotes* Clemens).
Larva on *Carex*, especially *C. pubescens* and *cristata*, and on *Scirpus;* mines milar to those of *A. enitescens*, several being made by a single larva, the rva with the same habit of retiring to the base of the mine by day. Larva ale green or whitish, with a pair of prominent, dark brown spots, sometimes -shaped, on the prothorax. Cocoon and pupa similar to *A. enitescens*, pupa coader with rougher thorax, and a beaded ridge with a broad sinus at its iddle, across the vertex. Moth in late May and June, rarely flying into July.
Pennsylvania and Ohio; abundant in Ohio.

5. **A. argentosa** Braun. Thorax deep golden brown, shading into metallic gray hind; head also metallic gray, antennæ wholly black-brown. Fore wing nearly ack, with a fascia and costal and dorsal streaks as in *A. enitescens;* but bluish- lvery, the fascia produced outward a little on the inner margin, and the costal reak curving out at its lower end to the apex of the membrane, where it may broadened, and sometimes meets the dorsal streak. Legs silvery gray, middle biæ and all tarsi dark brown, with tips of segments silvery. 7–7½ mm.
Larva in a narrow-leaved Carex, mine extending down from the tip of a leaf, ing nearer the upper epidermis, the larva consuming most of the parenchyma. pidermis slightly wrinkled at point of exit of larva, which is not always at ne extreme base of the mine. Pupa in a slight cocoon of very irregular meshes; out, ovate, shining, and chitinous, with rows of minute tubercles on dorsum

and prominent tubercles on sides of mesothorax, faint lines of tubercles on wings and prominent tubercles on front of head. Moth in June.

The costal streak of this species corresponds to the fused costal streak and apical spot of *A. madarella*.

Clermont County and Cincinnati, Ohio.

6. **A. prælineata** Braun. Black, face lead-colored, palpi fuscous, paler above with two bands on third segment; tips of tegulæ and a few scales on disc of thorax white; fore wing with white base, a slightly curved erect fascia two-fifths way out, and costal and dorsal spots nearly opposite each other, four-fifths way out; apical fringe white. 7 mm.

Mine on *Hystrix patula*, at first a line, then a blotch 4 to 5 mm. wide, usually on the under side of the leaf. Mine in early July; moth in August. Pupa stout and shining, heavily tuberculate.

Ohio

7. **A. cucullata** Braun. Black; palpi white, second joint brown outwardly, third sometimes with fuscous shading outwardly; antennæ black; face and head white; fore wing beyond base slightly brownish; a silvery fascia almost at base, broadened on dorsum, a second fascia just beyond middle, bent at middle of wing, and not quite reaching inner margin; a silvery subapical costal streak, and a dorsal triangle a little before it. Fringe and hind wing dark. 8–9 mm.

Larva in *Carex Jamesii;* mine, in the fall, a narrow tract, which is widened into a broad, inflated tract covering most of the width of the leaf, in the spring. Larva red, with browner head; thorax with pinkish mid-dorsal line, and abdomen with lateral pinkish lines also. Pupa elongate, tapering, with prominent dorsal and lateral ridges, the former bifurcated in front and ending on a pointed hood projecting over the face; pupa suspended by a girth and a few strands of silk. Moth emerging from middle of May to early June.

Cincinnati, Ohio. New York: Ithaca.

8. **A. albicapitella** Engel. Dark brown with purple iridescence. Antennæ dark brown, tips gray; face silvery; under side of second segment of palpi gray; lower edge of tegulæ and back of thorax white. Fore wing with base and first fascia as in *A. prælineata*, and with costal and dorsal streaks four-fifths way to apex, sometimes meeting; fringe powdery dark gray. 8 mm.

Larva in overwintering lower leaves of *Poa sylvestris;* the early part of the mine with parenchyma partly eaten, the later part somewhat inflated, and with almost all the parenchyma eaten. Larva pale yellowish, with two dark dorsal stripes on prothorax, widening and sometimes becoming confluent behind; mid-dorsal line whitish. Pupa stout, ovate, with prominent tubercles on sides of mesothorax, in a slight cocoon of transverse threads. Larvæ leaving mine at end of March, moths emerging in May or June (Ohio).

Pennsylvania and southern Ohio; Wisconsin.

9. **A. sylvestris** Braun. Blackish brown, with a faint golden brown luster. Face and front of head silvery gray; palpi with outer side of second joint and a little of apex of third blackish; apical fifth of antennæ whitish; tips of tegulæ and of mesothorax silvery. Fore wing with a silvery basal patch, a nearly vertical slightly irregular fascia just before middle, and large subterminal dorsal and costal spots, the latter farther toward apex.

Larva in stem-leaves of *Poa sylvestris*. Mine at first linear, at the margin of a leaf, inconspicuous; later mine in a second leaf, white, extending the entire width of the leaf and about 8 cm. long. Larva wholly pale yellow; pupa slender, elongate, dull except toward the head, with irregular tubercles on mesothorax; without cocoon. Mines in May; moths emerging in early June.

Cincinnati, Ohio.

10. **A. leucofrons** Braun. Blackish, slightly irrorated; face below antennæ with a white patch; palpi black below, with base of third segment white, white above with tip of third segment black; antennæ annulate with gray and fuscous; tegulæ

with white tips; fore wing with irroration sometimes forming faint longitudinal lines. Base of fore wing white, fascia narrow and irregular, oblique on costal and erect on dorsal half; a subterminal spot on inner margin, and a spot further out on costa, rarely obsolescent. Fringe with a line of black dots in base. Tibiæ and tarsi blackish, tips of segments and basal half of hind tibia white. 9–10 mm.

Mine on Hystrix and especially Elymus; whitish, on upper side of leaf, and usually extending its whole width, the under side of the leaf remaining green. Larva pale greenish or grayish, with narrow dorsal and broad lateral whitish lines, and a curved brown mark at rear of prothorax. Pupa attached flat to the leaf, head up; slender, elongate, not shining; with low rounded tubercles on sides of mesothorax and small ones on head; yellowish gray. Larva overwintering, the moths emerging in May.

Cincinnati, Ohio.

11. **A. præmaturella** Clemens. Palpi white above, fuscous below. Fore wing dull purplish black, dusted with white; head, thorax, and base of fore wing grayish fuscous, somewhat contrasting; antennæ darker. Fore wing with a white fascia before middle, and costal and dorsal spots toward apex, almost meeting. Extreme apex white, a row of dark scales in the fuscous fringe. 6–7½ mm. (*albapalpella* and *cristatella* Chambers).

Larva on nodding wild rye (*Elymus canadensis*); mine linear, becoming a blotch as wide as the leaf, 10–11 cm. long. Moth in April to June and August. Late specimens tend to be suffused.

Pennsylvania, Ohio.

12. **A. illectella** Clemens. Fuscous, dusted with dark brown. Head and palpi yellowish, antennæ fuscous. Fore wings with the fascia located before the middle, and spots nearly meeting four-fifths way out; a silver streak in costal fringe, edged with black. (*Cosmiotes* Clemens.)

Pennsylvania.

13. **A. maculosella** Clemens. Blackish, suffused with dark golden brown; head dark brown, palpi dull yellowish, antennæ fuscous. Fore wing with fascia at middle silvery; a spot on costa near apex; apex blackish, fringe grayish brown. 7 mm.

I have seen only the type, which is too poor to recognize.

Pennsylvania.

14. **A. unifasciella** Chambers. Brownish, iridescent with reddish purple. Palpi white. Fore wing with fascia just before the middle oblique, white, the ground much deeper beyond it; a small white spot just before the dorsal fringe begins, with a narrow white streak nearly crossing the wing just beyond it. Legs spotted with yellowish white. 6 mm.

Canada.

15. **A. irrorata** Braun. Dark gray, heavily dusted with black; palpi black beneath, gray above; antennæ black. Fore wing with a narrow, irregularly indented fascia just beyond one-third the wing-length; and costal and dorsal white dots just beyond two-thirds. Fringe with a series of black dots in base. Hind wing concolorous. Pale under side of abdomen less contrasting than usual. 8 to 11 mm.

Larva in leaf of *Glyceria nervata* (as a stray on *Agrostis*) in wet places. Mine linear, very narrow, yellowish green; starting at the base and terminating near the apex of the leaf, the larva retiring to the base by day, and feeding at night; more rarely in a short, detached mine at apex of leaf, which is deserted by day. Larva yellow when young, glaucous above when grown. Pupa attached to the upper side of a leaf near its base, head downward, broader and flatter than *A. leucothoraxæ*, with more tubercles on mesothorax, and stronger lateral ridges. Larva in early spring; moth in late May and early June.

Ohio; common.

Family 17. **DOUGLASIIDÆ**

(Elachistidæ; Glyphipterygidæ, in part)

Head about as in the other two families of the Elachistoidea; palpi intermediate in size, stout and drooping, the lower part of the face rather more smoothly scaled. Ocelli very large. Fore wing lanceolate; $\mathbf{R}_5$, when present, free from $\mathbf{R}_4$, but stalked with $\mathbf{M}_1$, running to costa; sometimes a radial absent; number of dorsal veins varying, but apparently all present in our species; **1st A** free, but weak; **2d A** strongly forked at base. Hind wing narrow-lanceolate, **Sc** ending about at middle of costa; **R**-stem running through middle of wing, bearing $\mathbf{R}_{2+3}$ on its anterior side two-thirds way out; one medial arising before, and one beyond $\mathbf{R}_{2+3}$. **Cu** simple, free.

Larva a leaf-miner on Rosaceæ and related plants. Larva short (fig. 132), fusiform, with normal head and eyes; front extending two-thirds way to vertex and adfrontals reaching vertex. Cervical shield with six setæ, arranged in a hexagon; prespiracular wart with three large setæ, and subventrals of all three thoracic segments with two; **ia** and **ib** obliquely placed, much like **i** and **ii** of the abdomen. Abdomen with **i** and **ii**, **iiia** and **iii** obliquely placed, similar, approximate, **iv** and **v** equal, approximate, and on a level; two upper setæ of **vii** widely separated from the lower one, which is on the leg base; prolegs small, rather near midventral line, apparently without hooks; proleg of seventh segment smaller than the others; ninth segment with setæ **iv** lower than **ii**, nearest to **iii**. Spiracles circular, pupa not studied.

This larva appears as aberrant as the moth, and helps little in placing the family, which is only tentatively associated with the Cycnodiidæ.

TINAGMA Zeller

(*Douglasia*, in part)

Palpi rough-scaled below; wing scaling not shining. Antennal segments of normal length, with single whorls of very slender scales (fig. 131). Larva on Potentilla, Geum, and related Rosaceæ.

1. **T. obscurofasciella** Chambers. Blackish, dusted heavily on a dirty white ground, the effect mouse-gray, the bands yellowish brown, lightly dusted and more or less defined with black. A broad band, with slightly excurved outer boundary at middle of wing, and extending almost to base, lightly edged with white; and a more irregular diffuse fascia near apex, not reaching costa; apex yellower. 7 mm. (*crenulellum* Engel; *Douglasia* Chambers.) Moth probably generally distributed but overlooked; flying in May.

Ontario to southern Ohio. New York: Black Brook (Clinton County), Rock City (Cattaraugus County).

Family 18. HELIOZELIDÆ

(Elachistidæ, in part)

Head smoothly scaled, broad, with small eyes, like the Elachistidæ, but with the palpi shorter and drooping. Antennæ short, with thick joints, scape small, shaft with scaling as in Elachistidæ. Tongue short, with some scaling at base, the base covered over with a rough tuft of scales between the palpi. Maxillary palpi absent. Hind tibiae with stiff hair. Fore wings lanceolate, with four veins running to costa and four to inner margin from the central cell; or venation more reduced, without cell, $\mathbf{R}_5$ and $\mathbf{M}_1$ stalked, forking over the apex. Anal region rather broad, the anals free and simple. Accessory cell never indicated. Hind wing with **R** widely separated from **Sc**, the three medials arising from it separately, or venation reduced, with a single free medial. **Cu** separate; forked, or simple; anal region reduced.

Larva forming a blotch mine, which is small, apparently indicating that the larva feeds largely on sap in spite of its mandibles being of the biting type; frass voluminous, sometimes nearly filling the mine. Larva at pupation cutting out an oval piece of the mined leaf, of which it forms a lenticular case much like that of the Adelidæ. Legs wanting; front reaching vertex (?); abdomen with setae **iv** and **v** rather close together. Larva strongly flattened, as usual in leaf-miners. Pupa with all appendages free and separate; very lightly chitinized, with spines on dorsum in obscure patches, hardly developed; abdomen with third to seventh segments free, and eighth in male. No maxillary palpi; labial palpi exposed; antennæ half as long as wings. Labrum forming a well developed free lobe projecting over base of labial palpi.

In habits and pupa the family is distinctly primitive, but in larval and imaginal structure, more specialized than *Aphelosetia.*

Key to the genera

1. Fore wing with lanceolate cell; hind wing lanceolate.
   2. $\mathbf{R}_1$ present, arising well toward base; hind wing with three medials. (Fig. 134) ..... **Antispila.**
   2. $\mathbf{R}_1$ absent; hind wing with a single medial, free from **R**. (Fig. 135). **Heliozela.**
1. Fore wing without cell; hind wing linear. (Fig. 133) ..... **Coptodisca.**

ANTISPILA Hübner

Fore wing (fig. 134) with $\mathbf{R}_{3+4}$ and $\mathbf{R}_5$ sometimes stalked with $\mathbf{M}_1$. Hind wing with $\mathbf{M}_1$ occasionally lost, **R** running to apex or just above.

The species are dark brown, with more shining silvery face, the fore wing with a fascia a third way out, and usually spots at two-thirds, the dorsal spot rather nearer the base. The key may not apply invariably and the species are best identified by breeding.

Key to the species

1. A white apical spot.
   2. Outer joints of antennæ white.....1. *hydrangiæella.*
   2. Only the minute last two joints of antennæ white.....2. *ampelopsiella.*
1. No apical spot.
   2. Costal spots extend into an angulated fascia.....3. *major.*
   2. Costal spot moderate.
      3. Fascia curved, turning obliquely in to inner margin at basal angle; narrow, half as wide on inner margin as the dark areas before and beyond it.
         4. Antennæ wholly dark.....5. *isabella.*
         4. Apical joint of antennæ white.....6. *viticordifoliella.*
      3. Fascia straight, rather beyond basal angle, at inner margin nearer to silver spot than to base, and as wide as the dark areas before and beyond it.
         4. Antennæ with white apical segment; ground usually coppery. 4. *cornifoliella.*
         4. Antennæ all dark, ground usually greenish.....7. *nyssæfoliella.*

1. **A. hydrangiæella** Chambers. Similar to *ampelopsiella,* the apical spot bright silver and as large as the pre-apical ones. 5 mm.

Mine and case like those of *A. viticordifoliella* on *Hydrangea nivea.* Moth in August.

Kentucky; southern Ohio.

2. **A. ampelopsiella** Chambers. A small dot of silver scales at apex. 5 mm.

Larva on Ampelopsis. Moth in August.

Kentucky; Missouri; Ohio; New York: Fort Edward.

3. **A. major** Kearfott. Middle third of antennæ silvery white; fore wing with base broadly metallic; fascia very narrowly interrupted at middle; dorsal dash narrow, extending up and out, about half in the fringe; a fascia across the wing just before the apex, not extending into the fringe, nearly broken at the middle, and zig zag like a thick S. 9 mm.

Moth in early June.

Black Mountains, North Carolina.

4. **A. cornifoliella** Clemens. Antennæ dark brown, scape somewhat ochreous. Fore wing not very bright, with a coppery hue; fascia rather narrow, not constricted on the fold, less distinct, and suffused with copper toward costa. Ground bright coppery toward apex, with the usual two golden spots. 7½ mm.

The larva mines *Cornus florida* in September. It is white, with dark brown head and neck, and series of dorsal and ventral dots.

I have seen material from Cincinnati, Ohio.

5. **A. isabella** Clemens. Almost like *A. viticordifoliella*; sometimes with the greenish iridescence of *nyssæfoliella.* 6 mm.

The moth has been found in May. The larva mines grape, cutting out a circular case; it is yellowish white, with brown dots at the middle of the body dorsally and a single ventral one.

Pennsylvania; Missouri.

6. **A. viticordifolielia** Clemens. Moth brown with a brillant coppery tinge and silver fascia and spots; differing from *ampelopsiella* only in the lack of the minute silver apex, and probably not a distinct species.

Larva yellowish green, without dorsal or ventral spots; cutting out a small oval case for pupation.

Pennsylvania.

7. **A. nyssæfoliella** Clemens. Antenna dark brown with the scape yellow, as usual; green tint of ground variable, and not strong; golden markings broad,

the fascia much broader at inner margin than at costa; outer spots more obliquely placed than in the grape species. 7½ mm.

Larva with dorsal spots rather fine, and a couple of ventral ones forming a dark line; mining on *Nyssa multiflora;* case oval.

The moth emerges in May and can be certainly identified only by breeding.

Pennsylvania; New York; New Jersey; District of Columbia. New York: Mohonk Lake (larvæ); Glens Falls and New York City (Lintner).

There is also a species on sweet fern, which has not been distinguished from *A. isabella.*

HELIOZELA Herrich-Schæffer

Fore wing (fig. 135) with only three veins running to costa; hind wing with only one medial. Our species has not been examined structurally, and may be an Antispila, but the markings are rather as in Heliozela.

1. **H. æsella** Chambers. Deep purple-brown, with two fasciæ, starting from inner margin near base and at middle of wing, tapering above, and only reaching halfway to costa; the basal fascia broader and blunter. 6 mm.

Larva in a flattened gall on leaves of grape; the gall lying on both sides of a vein, and almost completely eaten out before the maturity of the larva. Pupal case cut from the epidermis of the gall, at first oval, but made over into a spindle shape. Larva mature the middle of June; moth emerging about the first of the following May.

District of Columbia to Ohio.

COPTODISCA Walsingham

(*Aspidisca* Clemens, not Ehrlich)

Head and body characters like Antispila; eyes very small and not visible from above. Fore wing (fig. 133) without cell, the **R**-stem giving off R_1 from its anterior side near base, and two veins to inner margin near apex; the main stem terminating in costa near apex (probably R_{4+5}). Rest of **M** and **Cu** obsolete; **A** simple. Hind wing narrower, linear-lanceolate, **Sc** simple, short; **R**-stem simple, in middle of wing, forking over apex, with a branch from lower side at middle; **Cu** long, simple.

Larva and pupa essentially like Antispila. Mine relatively smaller, often almost entirely filled with frass, except the part cut out to form the case, which is kept clean.

The various nominal species are described from specimens bred from different food plants, but the imagoes are nearly indistinguishable; very possibly several are merely slight food-varieties of a single species.

1. **C. splendoriferella** Clemens. Head bronzy; antennæ fuscous, tinged with golden; basal half, or rather more, of fore wings lead-gray, slightly metallic; from middle to tip golden, with a broad, nearly straight, triangular, silvery streak running from costa three-fourths way (near tip of broad part of wing) to center of wing, dark-margined on both sides; nearly joined by a dorsal streak opposite it, with converging dark margins, behind which is a dark brown blotch. In costo-apical fringe a silver streak edged on both sides with black. A black apical spot with bluish-silver center. Dorsal fringe brown with a black basal line interrupted by the silvery streak. Hind wing leaden gray, fringe yellowish brown. 4–4½ mm. (*Aspidisca* Clemens; *pruniella* Clemens; *Lyonetia saccatella* Packard).

Mine at first linear, then a small transparent blotch, the cocoon using almost all of the clean part; on Cratægus, wild cherry, and apple.

The species is general. New York, Ithaca, East Greenbush, Albany, Fishkill.

Some of the following species may be valid, or all may be food-varieties of *splendoriferella*. Besides these species, larvæ of the genus have been found on several other food plants, but not distinctively named.

2. **C. lucifluella** Clemens. Larva on hickory. Moth slightly grayer than *splendoriferella*, the golden area toward apex forming a broad band on costal third only; rest of ground of outer half solidly dark brown; the gray basal portion somewhat less extensive, and the markings generally not quite so far out.

Cocoons may be found on the trunk under loose bark.

3. **C. ostryæfoliella** Clemens. Larva on iron-wood (Ostrya); the mine larger than usual in the genus, and the case comparatively small.

The moth looks like a somewhat more richly colored *splendoriferella*, with somewhat more extended golden area.

4. **C. saliciella** Clemens. Larva on willow. Practically indentical with *splendoriferella* but with the brown patch less sharply set off from the yellow; with two full rows of yellow scales between it and the black apical spot.

Missouri; Washington.

5. **C. diospyriella** Chambers. Larva on persimmon. Moth markedly variable, being either more or less yellow than *splendoriferella*.

The moth flies in June in Ohio.

6. **C. ella** Chambers, from hickory, is probably a strict synonym of *lucifluella*.

7. **C. juglandiella** Chambers. Markings of moth like those of *splendoriferella*, but larva feeding on black walnut; the case smaller; and the moth appearing earlier.

8. **C. magnella** Braun. Larva on Gaylussacia in August, in the usual mine. Moth with the blackish area beyond the dorsal spot reduced, not extending beyond it toward costa, and sometimes practically confined to the fringe.

9. **C. negligens** Braun. Head, thorax and basal half of fore wings pale leaden-metallic. Antennæ blackish. Apical half of fore wing bright *orange*-yellow, more orange than any other species of the genus. Black and silvery apical markings essentially as in *C. splendoriferella*.

Larva mining cranberry in May; working in the overwintering leaves. Moth in June. One brood; apparently hibernating in the egg stage.

Buckeye Lake, Ohio.

Another rather distinct form occurs on white oak.

SUPERFAMILY GELECHIOIDEA

Vestiture usually scaly even on the head (figs. 147, 148) which never shows the high bristling vestiture of the normal Tineidæ; ocelli small or absent; antennæ normally with dorsal surface scaled, with two rows to a segment; the outer row much longer than the other and often encircling the antenna. Ventral surface bristled, the bristles very long in some Blastobasidæ and Œcophoridæ. Antennæ pectinate in some exotic forms (see Ptochoryctis). Palpi almost always upturned beyond middle of front, the third segment long and pointed, regularly tapering for most of its length (unlike the fusiform segment of most Tineoidea and Tortricoidea); second joint frequently with a tuft, which is usually less ragged than in the Tortricidæ; never bristled; third segment rarely tufted. Palpi rarely reduced (Pigritia group; fig. 179). Tongue usually moderate, scaled at base; maxillary palpi, when present, characteristic, minute, but of folded type, and curving over base of tongue; absent in forms with much reduced mouth parts. Epiphysis large. Palpi and tarsi never bristled or spined; hind tibiæ rarely bristled, but almost always hairy.

The legs are not displayed as in the Heliodinidæ, and habits of display are less common than in that family and the Glyphipterygidæ, but are shown, for instance, by *Stomopteryx agrimoniella.*

Wings highly variable in form and venation; but the fore wing always with an ample cell, frequently with a well-marked accessory cell imperfectly set off from it. $\mathbf{R}_5$ often running to the outer margin, but only in primitive forms with broad wings, $\mathbf{R}_4$ also terminating in the outer margin in a few exotic *Xyloryctidæ*; **1st A** commonly lost (in the whole large family Gelechiidæ); **2d A** more or less forked at base. Hind wing variable, normally oval, but also trapezoidal, or even bifurcated in the Gelechiidæ, narrowing in other forms till it is linear in some Cosmopterygidæ; **1st A** varying as in the fore wing, and **3d A** also often vanishing with it; **2d A** forked as usual. Costa often sinuate and often bearing a tuft of bristles two-fifths way out. $\mathbf{R}_1$ frequently distinct, becoming free in a couple of the most reduced genera. Base of **M** obsolete in both wings. Female frenulum of few (normally two or three) bristles.

The egg is of the flat type and is laid externally: so far as I know, always singly. The larva (fig. 150) always has three setæ on the prespiracular wart, and a single subventral on the meso- and metathorax, and the prothoracic spiracle normal. On the abdomen, setæ **iv** and **v** are closely approximated, **i** and **ii** separated and usually at nearly the same level; on the ninth abdominal segment, **ii** is not

much nearer the mid-dorsal line than the other subdorsals, and is usually nearer to i than to its mate. Normally the prolegs have their hooks arranged in a complete or broken ellipse; they are always uniserial but often triordinal. Secondary hair occurs in Blastodacna, a few subprimaries in Ethmia. The habits are various.

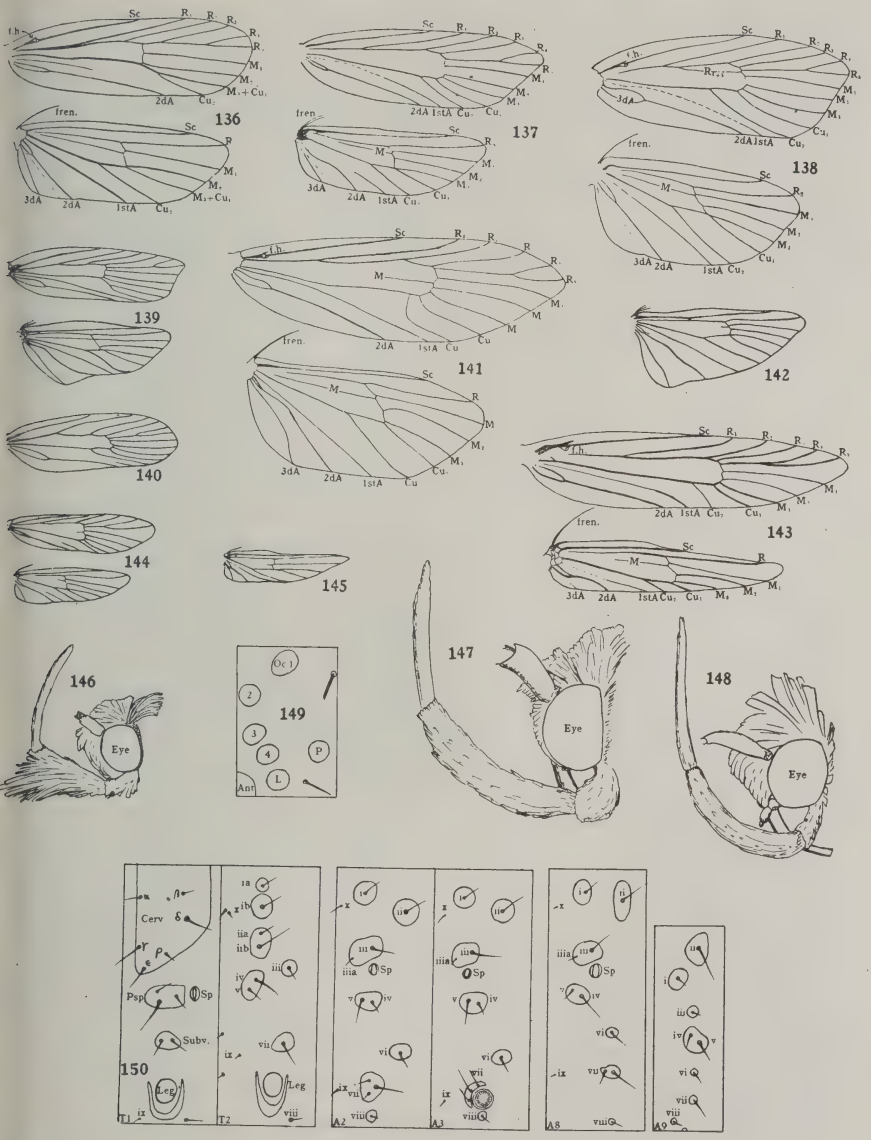
The pupa is also characteristic and is obtect; usually the abdomen is capable of dorso-ventral motion only, at three incisures. The body is depressed. The epicranial suture is present. The prothorax is hardly narrower on the mid-dorsal line than at the sides. The first four abdominal segments are usually longer than the others. The antennæ are usually adjacent for some distance on the midventral line.

The Gelechioidea form the most homogeneous of the subordinate groups of Microlepidoptera, and the largest of those groups. The Thyrididæ show some points of resemblance but will better be treated with the Pyralidoidea. Besides these only the genera Scythris and Euclemensia might perhaps be placed in this superfamily.

Family 19. ŒCOPHORIDÆ

(Depressariidæ; Gelechiidæ, in part)

Moderately small moths, rather larger than the average size of the Tineoidea. Head, typically, smoothly scaled, often somewhat rough. Labial palpi long, upturned, reaching or surpassing the vertex, the third joint nearly as long as the second, which is normally closely scaled, or with a longitudinal divided tuft. Tongue developed, scaled. Antennæ most often without pecten, never with eye-cap; both rows of scales on the segments broadly interrupted in Semioscopis, Ethmia, and a few other forms, as in the Macrolepidoptera. Hind tibia with long loose hair, sometimes rather bristly, the bristles gathering into tufts at the spurs. Tarsi nearly smooth, the spinules covered with scales. Fore wing with $\mathbf{R}_4$ and $\mathbf{R}_5$ stalked, rarely united; the other veins most often free; never with more than one vein lost. $\mathbf{Cu}_2$ arising well out toward the end of the cell, which is normal. **1st A** preserved toward margin, **2d A** forked at base. **1st A** very rarely appearing like a fork near tip of **2d A**, as in many Cosmopterygidæ. Hind wing with **R** separate from **Sc** but closely parallel on the basal part of the cell, often connected to it by an oblique cross vein ($\mathbf{R}_1$), which rarely is as strong as the other veins (Endrosis; Ethmia, in part). **R** and $\mathbf{M}_1$ well separated at origin and parallel halfway to margin, then divergent, but rarely more than twice as far apart at margin as at origin; apex more or less rounded; the outer margin not distinctly concave below the tip of **R**. $\mathbf{M}_3$ usually connate or stalked with $\mathbf{Cu}_1$, $\mathbf{M}_2$ usually from below middle of end of cell, stalked with **Cu** in Triclonella, arising from cell nearer $\mathbf{M}_1$ than $\mathbf{M}_3$ in Ethmia



FIGS. 136–150. ŒCOPHORIDÆ

136, *Martyringa latipennis*, venation; **137**, *Eumeyrickia trimaculella*, venation; **138**, *Cryptolechia tentoriferella*, venation; **139**, *Agonopteryx costosa* (Europe), venation; **140**, *Depressaria heydenii* (Europe), venation of fore wing; **141**, *Semioscopis avellana* (Europe), venation; **142**, *Ethmia pusiella* (Europe), venation of hind wing; **143**, *Borkhausenia* species, venation; **144**, *Dasycera imitatrix* (Europe), venation; **145**, *Endrosis lacteella*, venation of hind wing; **146**, *Eumeyrickia trimaculella*, side view of head; **147**, *Cryptolechia tentoriferella*, head; **148**, *Psilocorsis* species, head; **149**, *Depressaria heracliana*, arrangement of larval ocelli; **150**, *D. heracliana*, seta map of larva

and Eumeyrickia. Hind wing variable in width, typically sublanceolate, with the anal region a little reduced, but more commonly ample, and fully as broad as fore wing; **2d A** more or less distinctly forked at base.

The family is close to the Blastobasidæ, but the pecten is never as heavy, there is no stigma at the termination of $\mathbf{R}_1$, the veins do not show any distinct tendency to be grouped at the angles of the cell, and **Sc** is free from **R** in the hind wing.

Larva (fig. 150) typical of the superfamily: — head normal in form; all legs present and normal; normally with a biordinal ellipse of hooks, broken on the outer side; typically without secondary setæ; **iii** of abdomen in front of spiracle and slightly higher, single; head with adfrontals reaching membrane of vertex; front reaching two-thirds way to vertex; fourth ocellus much closer to third than to lower, second much closer to third than to first. Larvæ more or less concealed feeders; usually web or rolled leaf; Endrosis a scavenger.

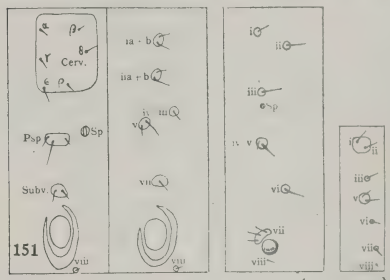


FIG. 151. ETHMIA PUSIELLA (EUROPE) SETA MAP.

Pupa with epicranial suture present, frontoclypeal imperfect or absent; maxillary palpi large, usually in contact with maxillæ, but labials and front femora concealed; antennæ in contact for some distance on the middle line, then normally diverging and exposing the hind tarsi. No hooked setæ on venter of ninth segment of abdomen.

The genus Ethmia (figs. 142, 151) is strongly aberrant in the early stages and slightly so in the imago, and is sometimes made the type of a distinct family, or transferred to the Yponomeutidæ. $\mathbf{M}_2$ arises from the middle of the end of the cell, much nearer to $\mathbf{M}_1$ than to $\mathbf{M}_3$. $\mathbf{R}_1$ when distinct, is near the middle of cell or beyond (one-fifth way out normally) and the genitalia are distinctive. The larva has the hooks of the prolegs in a single band; its front is shorter, ending abruptly, and its adfrontals do not reach the vertex; sometimes there are additional hairs in group **vii** of the abdomen. The pupa has not been studied. The imago of Eumeyrickia shows essentially the same characters.

The family is large, and primitive for the superfamily, being much better developed in Australia than elsewhere. The Cryptolechia group appears primitive, Depressaria leads to the Gelechiidæ, which are very closely related, and Endrosis, to the Blastobasidæ. Most of the Cosmopterygidæ appear to be reduced Œcophoridæ.

Key to the genera

1. R_3 and R_4 stalked with R_5, M_2 lost (fig. 136).....1. **Martyringa.**
1. R_3 free.
2. R_5 running distinctly to outer margin; all veins present (fig. 138).
3. Palpi with a triangular tuft on under side of second joint (fig. 146).
2. **Eumeyrickia.**
3. Palpi smooth-scaled, slender (fig. 147).
4. Cu_1 and Cu_2 of fore wing closely approximate at origin.....5. **Psilocorsis.**
4. Cu_1 and Cu_2 remote at origin.
5. Hind wing with R and M_1 divergent, palpi not reaching vertex, pecten present .....3. **Gerdana.**
5. Hind wing with R and M_1 parallel (fig. 138), palpi far beyond vertex, no pecten .....4. **Cryptolechia.**
2. R_5 to costa or apex (figs. 139, 140).
3. Abdomen strongly flattened, palpi with divided tuft on second joint, pecten present.
4. Cu_1 and Cu_2 of fore wing stalked (fig. 139).....6. **Agonopteryx.**
4. Cu_1 and Cu_2 of fore wing separate (fig. 140).....7. **Depressaria.**
3. Abdomen cylindrical; second joint of palpi without longitudinally divided tuft. The species with broad hind wings, which run here, lack the pecten.
4. Hind wing with a median missing; M_2 stalked with Cu_1 (fig. 145).
17. **Endrosis.**
4. Hind wing with all veins preserved.
5. M_3 and Cu_1 of hind wing separate at origin.
6. Fore wing with a radial lost.....12. **Decantha.**
6. All veins present; costa concave (fig. 219, p. 356).
(**Euclemensia:** Heliodinidæ.)
5. M_3 and Cu_1 connate or stalked.
6. Fore wing with one radial missing (R_4 and R_5 completely fused).
13. **Fabiola.**
6. All veins present; R_4 and R_5 stalked.
7. Antennæ thickened with scales on shaft, toward base..14. **Œcophora.**
7. Antennæ not specially thickened toward base; the segments about twice as long as wide.
8. M_2 connate or stalked with M_3+Cu_1.....15. **Triclonella.**
8. M_2 free (fig. 143).
9. Antenna with pecten.....16. **Borkhausenia.**
9. No pecten.
10. Hind wing obtuse, as wide as fore wing.
10. Hind wing lanceolate, three-fourths as wide as fore wing.
11. **Schiffermuelleria.**
11. Hind wing with M_2 nearest M_1 (fig. 142).....10. **Ethmia.**
11. Hind wing with M_2 rather nearer M_3, rarely central (fig. 141).
12. Fore wing with Cu_1 and Cu_2 approximate or stalked; hind wing ample.....9. **Semioscopis.**
12. Fore wing with Cu_1 and Cu_2 widely separate at base.
8. **Inga.**

1. *MARTYRINGA* Busck

(*Œgoconia* Walsingham)

Antennæ heavy, flattened, strongly serrate; no pecten; no ocelli, palpus upturned beyond vertex, second segment a little thickened, third about as long as second. Fore wing (fig. 136) more than three times as long as wide, with rounded outer margin; M_1 arising well below angle of cell, M_2 lost, M_3 approximate to Cu_1 and Cu_2, which are stalked; 1st A apparently lost; R_5 running to apex or costa. Hind wing ample, M_3 lost, M_2 connate with Cu_1. M_1 from a third way down end of cell.

A curious form, looking like a Depressaria, but with some Gelechiid characters. Early stages unknown.

1. **M. latipennis** Walsingham. Clay color, dusted with blackish, and with slightly blurred blackish marks; middle half of costa dark-shaded; base also more broadly shaded with dark. Orbicular and claviform spots oval, black, rarely fusing, reniform the larger, and squarish, the region beyond it darker almost to the margin, defining a pale, irregularly sinuous postmedial line. Terminal line gray, narrow. Hind wing paler and grayer. 15 mm.

July to August.

Known from southern Connecticut to North Carolina and Missouri; New York: Ithaca.

2. *EUMEYRICKIA* Busck

Palpi with triangularly tufted second joint and much longer, very slender third joint (fig. 146); antennæ slender, normal, without pecten; no ocelli. Fore wing (fig. 137) more triangular than usual, with subfalcate apex and arched costa. R_4 and R_5 forking over apex, the other veins separate, Cu_2 straight. Hind wing ample, with veins R to M_3 nearly evenly spaced, and M_2 almost connate with Cu_1.

Busck suggests that this genus is related to Ethmia. The moth favors hollow trees, and struts about with wings elevated like some Glyphipterygidæ.

1. **E. trimaculella** Fitch. Third joint of palpus blackish with two longitudinal white lines, not quite reaching base; second joint white-tipped and with white patches on inner side. Fore wing fuscous, dusted heavily on a luteous ground, leaving two pale costal spots toward apex and other faint markings; fringe dark with a double series of pale bars. Hind wings dark. 13 mm.

The moth flies in June southward, and in early July in the North.

Parry Sound, Ontario, and Megantic, Quebec, to North Carolina and Ohio. New York: Upper Ausable Lake.

Eido albapalpella Chambers. (*Venilia* Chambers, not Duponchel) has never been identified and may be the same species as the preceding; but as described the palpus is paler, the third joint is white, except for the blackish base, and the second white on its inner side.

Kentucky.

3. *GERDANA* Busck

Palpi somewhat loosely held, upturned nearly to vertex, with slightly rough and thickened second joint, and somewhat shorter third; pecten present; abdomen slightly flattened. Fore wing elongate, ovate, blunt; veins M_2 to Cu_1 approximate at lower angle of cell; R_5 reaching margin just below apex; Cu_2 remote. Hind wing with costa sinuate, R and M_1 distant but divergent. M_3 and Cu_1 connate or stalked. The habitus of this genus is rather like that of Depressaria.

1. **G. caritella** Busck. Straw to ochre yellow, suffused with darker brownish yellow; palpi brown; face, head, and thorax lighter; fore wing with basal half of

costal edge somewhat dusted with fuscous; two obliquely placed dark dots at one-third, and a series of three at end of cell, the discal largest; sometimes the three fused into an oblique band. A strongly bent subterminal band parallel to tip of costa and outer margin. Apex infuscated. Markings tending to disappear in rubbed specimens. Hind wing whitish, abdomen and fringes straw. 13 mm.

The moth occurs in July and August.

Southern Massachusetts to Ohio, Maryland, and Texas. New York: Ithaca.

4. *CRYPTOLECHIA* Zeller

(In part; *Machimia* Clemens)

Similar to Gerdana; palpi much longer, second joint reaching vertex; wings in our species more ample. This genus also occurs in Africa and Australia (figs. 138, 147).

1. **C. tentoriferella** Clemens. Light ochreous; when fresh, more or less shaded with reddish and dusted with black; two contrasting discal dots, and a blackish spot in fold halfway between them; a broken punctiform postmedial line parallel to outer margin and a series of black terminal dots. Head pale, palpi nearly white, with basal half contrasting blackish. Hind wing lightly infuscated. 22 mm. (*fernaldella* Chambers).

General in distribution; common in late August to October on trunks of trees. Caterpillar in August on oak, cherry, maple (?), chestnut, etc., in a flat tent on under side of leaf at one side of midrib, bending the leaf; feeding outside the tent. Caterpillar dark green. Cocoon under a folded edge of the leaf; of dense silk except at the point where the moth emerges.

New York: Potsdam, Ithaca, Big Indian Valley, Schenectady, Karner, Rhinebeck, New Windsor, New York City; Moravian Cemetery, Staten Island.

5. *PSILOCORSIS* Clemens

(*Cryptolechia,* in part)

No pecten. Palpus very long and slender; third joint nearly as long as second (fig. 148). Fore wing with squarish apex and more vertical outer margin than in Cryptolechia; R_5 rarely running to the apex, as in some Depressarias, from which the genus is distinguished by the lack of pecten, and by its smoother palpi. Ground color luteous to light brown. Second joint of palpus with a black ventral line edged on both sides with white; third joint white with three black lines, the middle one continuous with the line on the second joint. Scape of antennæ with two black lines with a white one between them; shaft on upper surface normally with two longitudinal black lines toward base, with white between them, becoming transversely barred with brown outwardly; the under side evenly pale. Fore wing transversely strigose with darker brown or black, usually with a black terminal line and sometimes with a dark fringe, but without other sharply defined markings.

All the species are very similar and are practically impossible to determine without a knowledge of the larva.

The larva lives in a slight web between two leaves of the food plant, skeletonizing the leaves, which turn brown. It has rather distinct tubercles; on the eighth segment of the abdomen, iii is directly in front of the spiracle, and iv and v, below it. Pupation takes place in the web.

1. **P. quercicella** Clemens. Luteous, strigose with brown. Terminal line black, broken, contrasting, variable in length; fringe lead gray. A dark shade across

wings beyond middle, or a patch in fold, which is rarely obscure. Fore tibia solid brown, or with a complete, broad, longitudinal stripe. 12–15 mm.

Larva on oak and chestnut in September; pale yellowish or greenish; head and entire thorax black. Moth in March and April; and in July.

Generally distributed. New York: New Windsor (Morton).

2. **P. obsoletella** Zeller. Closely similar to *P. quercicella*, but usually, slightly larger (16 mm.), and more evenly strigose; usually without the postmedial shade across the wing. Larva also on oak and chestnut, but with only prothorax black; mesothorax with some red on sides, and metathorax pale, like the abdomen.

Ohio. New York: Ithaca.

P. dubitatella Zeller appears to be a synonym of *P. obsoletella*, but without knowledge of the larva this must be a little uncertain.

3. **P. faginella** Chambers. Mouse-gray, with the strigæ less contrasting, deep brown; the terminal line reduced to about four dots at apex, inconspicuous. Longitudinal striping of antennæ unusually long, obscure; white lines on palpi very slender, broken. Fore tibia with a brown patch on anterior side. 13 mm. (*Hagno* Chambers).

Larva on beech; whitish with ferruginous head, some ferruginous on prothorax and a pinkish patch on each side of mesothorax.

4. **P. cryptolechiella** Chambers. Very similar to *P. faginella*, rather evenly colored, with slender, inconspicuous, broken terminal line and light fringe. Head, thorax, and base of fore wing reddish orange. 15 mm.

This species is unknown to me. It was bred from holly. In the United States National Museum it is identified with a species from Vaccinium, known from Massachusetts to North Carolina.

5. **P. reflexella** Clemens. Fore wings dull straw color, strigose with fuscous, appearing dull fuscous brown. Terminal dots obscure; fore tibia slightly darkened. 20 mm. (*quercicella* Zeller, not Clemens; *cressonella* Chambers).

Larva on oak. Moth in June.

Massachusetts to Virginia. New York: Ithaca (determined by Chambers).

6. **P. ferruginosa** Zeller. Ground color and fringe, light ochreous, markings as in *P. reflexella*, with distinct black discal dot. Fore tibia light. 18 mm. (*confertella* Walker).

Maine to Ohio. New York: Otto.

7. **P. fletcherella** Gibson. Antennæ black, annulate with light ochreous; fore wing pale golden yellow, rather heavily dusted with pale brown, with purplish reflections; discal dot black, conspicuous; fringe ochreous, shaded with brown. Legs bright pale ochreous; fore leg sometimes dark; tarsal joints dark. 19 mm.

Larva on aspen poplar; yellowish green, head jet black, cervical shield blackish brown in middle, tubercles inconspicuous, a few blotches of crimson on eighth segment of abdomen, above spiracles; anal plate black.

Ottawa, Ontario.

Members of the genus have also been bred from Ambrosia, Amelanchier, and Carpinus, but not named.

6. *AGONOPTERYX* Hübner

(*Depressaria*, in part; *Agnopteryx*)

Similar to Depressaria, but with Cu_1 and Cu_2 stalked in the fore wing (fig. 139); hind wing less strongly lobed, as a rule.

The imagoes of this genus and of Depressaria emerge in the fall, often as early as August, and overwinter. They are often found under bark or flying by day in the early spring.

Key to the species

1. Thorax and extreme base of fore wing black, contrasting.....1. *atrodorsella.*
1. Base of fore wing not black.
2. Ground of fore wing pure white.
3. Ground heavily dusted with black, appearing ash gray.....20. *allenella.*
3. Ground not noticeably dusted with black.....2. *canella.*
2. Ground of fore wing not pure white.
3. Discal dot **d** with white or whitish scales in center much paler than ground.[17]
4. Discal dot **b** wholly or part white, or replaced by a larger irregular white dot; **a** and **c** often white also.
5. Ground grayish; extreme tip of palpi pale, tuft of palpi large and widening strongly to tip of second joint; wing generally smoothly scaled .....7. *nebulosa*; 8. *plummerella.*
5. Ground reddish, extreme tip of palpi black (except in *D. lythrella*).
6. No trace of a pale or dark postmedial fascia; white scaling of discal dots **a** and **b** often fused into a patch.
7. Black dots **a** and **b** also fused into a crescentic mark; discal dot **d** a vertical bar; ground heavily shaded with blackish; third segment of palpus rough, pale-tipped.....16. *lythrella.*
7. Black dots **a**, **b**, and **d**, small, round; ground bright crimson, nearly even; third segment of palpus smooth, black-tipped.
6. *walsinghamella.*
6. A faint angulate postmedial line; discal dots all minute.
7. Fringe of hind wing reddish tipped.....(5.) *ciliella.*
7. Fringe of hind wing not reddish.....5. *applana.*
4. Discal dots **a** and **b** without white scales; usually showing as black points.
5. A contrasting curved black line on disc.
6. Ground mouse-gray .....14. *hyperella.*
6. Ground pale gray, tinted with red in fresh specimens..13. *curvilinella.*
5. No such mark; fore wing often with a vague squarish dark spot on disc.
6. Ground reddish, discal dot **d** often with a single white scale or a little transverse streak.....12. *fulva.*
6. Ground clay-color to ochre, discal dot **d** with half a dozen white scales in a rounded group.
7. A black patch in disc before discal dot **d**, usually obliterating **c**.
8. Patch larger; ground mottled on a bright ochre under-color.
3. *pulvipennella.*
8. Patch smaller; ground light, even clay-color; hind wing, below, very pale.....4. *argillacea.*
7. No black patch in disc; with raised scaling.
8. Palpi strongly tufted on outer half of second joint; hind wing, below, dusted with blackish.....8. *plummerella.*
8. Palpi nearly smooth.....9. *scabella.*
6. Ground dull fuscous gray, with contrasting ochreous base.
11. *nigrinotella.*
3. Discal dot **d** without any white scales, or any scales noticeably paler than the ground color.
4. With a continuous dark terminal line toward apex, and a curved black spot on disc.....16. *lythrella.*
4. A series of terminal dots.
5. Fore wing straw-yellow.....17. *flavicomella.*

[17] In this genus there are typically four dots in the cell. The first two are obliquely placed and present the orbicular, the outer two longitudinal, representing the reniform. I have indicated these om the base outward with the letters **a**, **b**, **c**, **d**. Some authors speak of **b** as the inner and **d** as the ıter discal dot.

5. Fore wing bright yellow, mottled with red.
6. A triangular darker shade at end of disc.....18. *robiniella*.
6. No such shade.....19. *lecontella*.
5. Fore wing dull red-brown, practically immaculate.....12. *fulva*.
5. Fore wing dull yellowish or grayish.
6. Thorax pale; fore wing mottled and scaled with white, base contrastingly paler; fuscous patch in cell faint; fresh specimens with slight pink suffusion.....15. *senecionella*.
6. Brownish ochreous; thorax darker, with a little black behind. 9½. *pteleæ*.
6. Anterior half of disc of thorax gray; wings evenly clay-color, the base hardly paler; patch in cell contrasting, small, nearly black, no pink .....10. ———
6. Wings powdery pale luteous, but without white; with fuscous, and raised black scales.....9. *scabella* and 8. *plummerella* (see above).

1. **A. atrodorsella** Clemens. Cream color; most of thorax and costal half of base of fore wing black; six or eight black costal dots; a rosy shade over end of cell, running into streaks on the veins; a dark costal-apical patch; black terminal dots, and rosy fringe. Upper part of face blackish, vertex rufous. 20–23 mm.

September to April. Caterpillar green, with darker dorsal and subdorsal stripes, blackish tubercles and spiracles; yellow-brown head, and a light cervical shield with a black dot at each side; feeding on Bidens, folding the leaf lengthwise.

New Hampshire to District of Columbia, west to Wisconsin. New York: Fentons (Lewis County), Crosby (Lake Keuka), Ithaca, Delmar, Schenectady, New Windsor, Staten Island.

2. **A. canella** Busck. White; palpi mottled with light brown, vertex brown; fore wings lightly dusted with black and brown scales except toward the base. Middle of costa with a black and brown shade. Discal dots **a** and **b** usually distinct, black or fused into a bar. Hind wings light fuscous with pale fringes. 20 mm.

July to September. The related European species, *D. alstrœmeriana*, feeds on Conium.

Southern New Hampshire; Connecticut; New York; Washington State. New York: Wilmington, Ithaca, Catskills.

3. **A. pulvipennella** Clemens. Clay color, more or less shaded with reddish and heavily dusted and shaded with black-brown, the whole effect powdery wood-color; base paler; costa with short black bars. Discal dots slightly raised in perfect specimens; **a** and **b** black, **d** with a white center, **c** obliterated, claviform indicated by a black dot; fringe reddish. Face and inner side of palpi whitish; vertex rose-brown, 22 mm. (*eupatoriella* Chambers, *solidaginis* Walsingham).

September to May; July; the summer brood probably dropping out northward. Very common. Caterpillar green, sometimes with darker dorsal and lateral lines. Tubercles, head, and cervical shield nearly concolorous; head marked with brown; cervical shield with lateral brown dots, anal plate brown-edged. Caterpillar folding the leaves of Eupatorium and Solidago lengthwise.

There is a rare coal-black aberration.

Massachusetts to Virginia, Illinois, and Missouri. New York: Fentons (Lewis County), Ilion, Crosby (Lake Keuka), Ithaca, Schenectady.

4. **A. argillacea** Walsingham. Pale gray, hardly yellowish, *lightly* sprinkled with black; a small blackish patch near end of cell; base of inner margin pale, followed by a blackish shade. Terminal dots weak, outer discal dots inconspicuous, the white centers dull and not contrasting. 20 mm.

This species is the American representative of *A. yeatiana*, which eats Umbelliferae. It has been taken in March and in September.

Connecticut; New Hampshire; central Missouri. New York: Ithaca.

5. **A. applana** Fabricius, race **clemensella** Chambers. Rose-brown, dusted and mottled with fuscous and sometimes luteous. Head, thorax, and base of wings more yellowish; the four discal dots white, black-ringed, the first with most black. Postmedial line dark, parallel to the outer margin, angulated below costa, obscure, and very easily overlooked. Costal edge heavily spotted with black and luteous white, almost completely crowding out the ground, even at the base of the wing. 18 mm.

August to April. Caterpillar on parsnip and wild parsnip (Heracleum). The European larva is green, with darker dorsal and subdorsal lines, black tubercles, and gray-green head.

Connecticut to District of Columbia. New York: Ithaca, New Windsor.

A. ciliella Stainton, a slightly larger and smoother-looking species with yellow-headed larva is to be expected, but not definitely recorded in the northeastern States.

6. **A. walsinghamella** Busck. Crimson red, brighter than *A. applana* and *A. ciliella;* middle half of wing toward costa sprinkled with whitish and black, leaving the base of the costa red, contrasting with the cream white base of the inner margin; discal dots **a, b,** and **c,** with their white portions usually fusing into a spot, their black portions distinct. 20 mm. (*Depressaria fernaldella* Walsingham, not Chambers, *hilarella* of authors, not Zeller).

Caterpillar on Myrica.

Orono, Maine, to Connecticut and Wisconsin. New York: Albany.

7. **A. nebulosa** Zeller. Powdery fuscous, a little yellower than *A. argillacea,* with inconspicuous raised black points, as usual in the group. The four ordinary discal dots distinct, their white scaling tending to be suffused and to unite them in pairs, (**a** and **b** being generally united) but dull and hardly paler than the ground color. Under side of hind wing striolate toward tip. Second segment of palpus with funnel-shaped tuft toward tip. 18 mm.

Apparently general in distribution.

8. **A. plummerella** Busck. Closely similar to *A. nebulosa.* Discal dots very inconspicuous, apparently separate; base of hind wing a little more whitish. 24 mm.

Plummer's Island, Maryland; Ohio. New York: Rock City (Cattaraugus County).

9. **A. scabella** Zeller. Second joint of palpus nearly smooth. Markings as in the last two species, the raised tufts, especially the one in the fold below discal dot **a,** more distinct; no well-marked white scaling. Under side of hind wing with scattered black dots toward apex, and a fine dark terminal line.

Ohio.

9½. **A. pteleæ** Barnes and Busck. Brush on second segment of palpus widest at middle, tapering to both ends. Fore wing rough with raised scaling. Thorax dark ochreous mottled with brown and black scales, the extreme posterior tip black; head redder. Fore wing ochreous with a large nearly round blackish shade over end of cell. None of the discal dots scaled with white. A series of ill-defined dark spots along costa, and obscure terminal dots. Hind wing light ochreous fuscous, the base and inner margin pale. Under side of abdomen with two series of black dots. 20–22 mm.

Larva on hop tree.

Decatur, Illinois.

10. **A.** ———— Clay-color. Palpus with two moderate dark rings on third segment. Anterior half of disc of thorax powdery gray. Base of fore wing paler, defined with a little blackish shading toward inner margin. Base of costal edge black. Most of wing with scattered black scales, the costa more distinctly barred. All discal dots black, a small black patch on disc. Under

side of fore wing with scattered light fuscous flecks, and a broken black termina line. 19 mm.

The only specimen before me was taken in April.

New York: Ithaca.

11. **A. nigrinotella** Busck. Palpi light yellow-brown, the base black-shaded an extreme tip black. Head light red-brown, thorax yellow-brown, — the front back, and tegulæ darker. Base and basal half of costa yellow-brown, the res of the wing brownish fuscous, with scattered black scales. Discal dot **d** only white-scaled. Hind wing shining light yellowish fuscous. 22 mm.

Larva on hop tree, with *A. pteleæ*.

Ohio; Illinois.

12. **A. fulva** Walsingham. Dull red-brown without yellow tint, with the usua paler base followed by a dark shade. Costa interrupted with black and yellowish 22 mm.

This form is easily distinguished from the other red species by the lack o white discal dots. The locality was not reported, and the species is very prob ably western.

13. **A. curvilineella** Beutenmüller. Head white, the fore wing grayish white shaded and mottled with pale pearl gray, with a more or less distinct pink tint leaving the base and costa pale, the wing lightly dusted with black scales, whic gather into larger black spots along the costa; first three discal dots fused int a black crescent, concave upward, the fourth one white, ringed with black. Hin wing also pale, with white fringe. 18 mm.

October to April.

New York to Missouri. New York: Ithaca, New York City.

14. **A. hyperella** Ely. Similar to *A. curvilineella;* most of the wing-surfac nearly evenly mouse-gray. Vertex dark gray, unlike even the darkest specimens o *A. curvilineella.* 16 mm.

End of May. Larva on *Hypericum prolificum* in April. Possibly a seasona form of the preceding species, which however appears to be single-brooded in th north.

Great Falls, Virginia.

15. **A. senecionella** Busck. Luteous, slightly shaded with pink, and strongly an irregularly with dull gray, leaving the base pale and sharply defined except a costa. Paler areas also over the discal dots **a** and **b** and beyond **d**, and a vague paler postmedial line. Third discal dot not distinct. Ground sometimes mor evenly gray. Hind wing pale gray, the veins darkest. 17 mm.

Larva in March; imago in May.

Plummer's Island, Maryland.

A. canadensis Busck, which is slightly more dusted with black, and has th base of the hind wing paler, is likely to occur in the west of our area.

16. **A. lythrella** Walsingham. Tawny reddish, heavily shaded with mouse gra and dusted with black and pale cinereous toward costa; a distinct dark spot i the dorsal part of the whitish base, normally nearly covering the pale area; thick, black, oblique crescent, edged with the reddish ground and followed by a group of whitish-cinereous scales. Discal dot **d** represented by a vertical whit bar. Terminal line continuous, fading out at apex. Fringe purplish gray. Hin wings mouse gray. 16 mm.

Caterpillar on *Lythrum alatum.* Dull whitish green, immaculate; webbing th leaves in June. Moth in July.

Illinois; North Carolina.

17. **A. flavicomella** Engel. Straw yellow, shaded with red-brown and flecke and obscurely striate with blackish or umber brown. Outer discal dot black. i a brown spot or shade; inner (**b**) a black point, or obscure; more or less distinc

traces of a postmedial fascia. Black bars on costa and terminal dots. Hind wing whitish. Blackish shade near base and shade over the discal dots typically strongly contrasting. 16 mm.

June and July.

Connecticut to North Carolina; Illinois. New York: Ithaca.

18. **A. robiniella** Packard. Yellow, heavily shaded and dusted with dull crimson red and a little fuscous, the latter forming a series of terminal dots. A vague triangular reddish shade over middle of wing, with a circular pale area before it containing discal dot **a**, and with the small pale discal dot **d** on its outer edge. A darker subterminal shade. Hind wing fuscous. Head and thorax concolorous with fore wing; abdomen, with hind wing. 18–20 mm. (*hilarella* Zeller).

Caterpillar on Robinia in June. Moth in July.

General in distribution. New York: Schenectady, Bridgetown, Rhinebeck, Crugers, Katonah.

19. **A. lecontella** Clemens. Head dull ochreous, with some fuscous on second, and two dark rings on third joint of palpus. Antennæ fuscous; thorax dull ochreous with two black-brown dots in front. Fore wings slightly darker, nearly evenly dotted with dark, and somewhat washed with rufous; a slight dark shade only on disc. Discal dots **a** and **d** distinct. Hind wing gray. 22 mm.

Caterpillar possibly on Sanicula and Pimpinella.

Vermont to Maryland and Ohio. New York: Ithaca, Schenectady, New Windsor; Sea Cliff, Long Island.

20. **A. allenella** Walsingham. Fore wings broader with more arched costa, with Cu_1 and Cu_2 sometimes only very closely approximate. Abdomen only slightly flattened. Pecten weak, palpi practically smooth. Fore wing with rough scales and a discal tuft. Pale gray; palpi powdery; fore wing minutely mottled and dusted with blackish, with somewhat more distinct black points on costa, especially toward base; a fuscous subterminal shade, more distinct on costa, and a slight streak in base of fold. Two black discal dots at end of cell. Hind wing of the paler gray ground-color. 18 mm. (*Semioscopis*).

June. Larva on oak.

Maine to Virginia and western Pennsylvania. New York: McLean, Rhinebeck.

7. *DEPRESSARIA* Haworth

(In part; *Schistodepressaria* Spuler)

Head somewhat rough-scaled, with small ocelli and maxillary palpi; labial palpi with a furrowed brush on under side of second joint, third joint long and smooth; antennæ with pecten. Abdomen markedly flattened, and wings folded flat over the back at rest. Fore wing more or less oblong (fig. 140) with blunt or rounded apex, R_5 running to costa or apex, Cu_1 strongly curved at base, Cu_2 well separated from it, often nearly straight. Hind wing broader, usually strongly lobed at anal angle, with all veins present; **R** and M_1 parallel, M_3 and Cu_1 connate or short-stalked, M_2 arising near M_3.

The fore wings tend much more to longitudinal marking than in Agonopteryx. The discal dots **a** and **b** usually fuse into a streak, and there is almost always a blackish bar along the base of the inner margin, in place of the pale base of most Agonopteryxes. The moths emerge in July and go immediately into winter quarters, coming out and laying their eggs the following March or April. The caterpillars (figs. 149, 150) live in webs on various plants, especially Umbelliferæ. The generic name Depressaria was formerly used to include a great variety of Œcophoridæ and even Gelechiidæ, mostly species with similar tufted palpi.

Key to the species

1. Base and costal edge whitish.....5. *cinereocostell*
1. Base and costal edge not whitish.
  2. With a pale fourth discal dot.
    3. Fourth discal dot white, conspicuous, and preceded by a long white lir
      7. *emeritell*
    3. Fourth discal dot less conspicuous, preceded by a heavy black bar.
      3. *maculatella*, 4. *symmochlot*
    3. Fourth discal dot less conspicuous and not preceded by a longitudin bar.
      4. Hind wing whitish, much paler than fore wing.....(1.) *togat*
      4. Hind wing light gray, paler at base.....1. *betulell*
  2. No pale fourth discal dot.
    3. A pale, acute-angled fascia.....6. *heraclian*
    3. No such fascia.....2. *grotell*

1. **D. betulella** Busck. Fuscous, obscurely mottled, with the pale base of inn margin most conspicuously contrasting; terminal dots present; black discal do obscure; head yellowish. 23 mm.

Caterpillar in a silken tube between leaves of black birch; pale green wit black tubercles. Moth emerging in June.

Vermont to Pennsylvania.

D. togata Walsingham, described from the Rocky Mountain district, is close similar but with rather darker fore wings and paler hind wings. It may enter th northern part of our territory northward, and has been reported from Vermon though apparently in error for the preceding species.

2. **D. grotella** Robinson. Dull straw color, second joint of palpi blackish below fore wing nearly evenly colored, a little redder on the disc, with vague longitudina streaks of fuscous, the one in the outer part of the cell hardly more contrastin than the rest, but present, the most distinct streaks being a postmedial serie between the veins. Fourth discal dot dark, terminal dots distinct; hind win pearl gray. 20 mm.

Caterpillar green, darkest dorsally; cervical shield green, unmarked; hea green with a black dot on each side above the jaws; on Corylus.

This species is unknown to me.

North Atlantic States. New York (Robinson).

3. **D. maculatella** Busck. Similar, crisply black-dusted on a chalk-white ground appearing *light gray*. Fore wing with fuscous streaks between the veins, mor or less interrupted by a faint, pale, dentate postmedial line; two pale discal dots with a heavy black bar in the cell between them, touching the first. 22 mm.

New Hampshire and Connecticut to Ontario and western Pennsylvania.

4. **D. symmochlota** Meyrick. Similar to *D. maculatella*, but ground *mous gray* or *fuscous*, with some pale shading and scaling, especially indicating the post medial line. Sparse black scaling on the dark portions. Bar in cell as in *D. maculatella*, conspicuous. 20 mm.

Late July to early August. Perhaps the same as *D. grotella*.

Sebec Lake, Maine; Parry Sound, Ontario; Manitoba.

5. **D. cinereocostella** Clemens. Fore wing reddish-brown, marked with numerou short black dashes; costa, head, and thorax normally much paler, whitish gray hind wing grayish fuscous. 18 mm.

Occasionally the costa is practically concolorous with the rest of the wing, bu such specimens are recognizable by their pinkish tint, distinct pale postmedia line of whitish scaling, minute or wanting fourth discal dot, and absence of any blackish shading in the cell.

Fresh moths occur in July The caterpillar is bright sulphur yellow with a

more ochreous cervical shield, and a dark ochre head, with black dots at the eyes. The tubercles and hairs are black. It folds and ties together leaves of water-parsnip (Sium) and caraway.

Massachusetts to Virginia. "New York" (Busck).

6. **D. heracliana** DeGeer. Luteous shaded with brown, forming longitudinal stripes or shades. Longitudinal stripes in cell, fold, and near base of inner margin; the stripes in the outer part of the wing lying between the veins, and interrupted by the angulate pale postmedial line; a dark discal dot. Palpus with two dark rings on third joint. 25 mm. (*umbellana* Fabricius, *pastinacella* Duponchel, *ontariella* Bethune.)

Caterpillar webbing together the flower heads and seeds, more rarely also the leaves of wild parsnip (Heracleum) and other Umbelliferæ, in June and July; usually entering the hollow stems to pupate. Green-gray, paler and yellower below, with head, plates, true legs, and tubercles black. Moth emerging in July and immediately retiring till the following spring. Of general distribution and decidedly common. New York: Crosby (Yates County), Ithaca, Albany, Rhinebeck, New Windsor, West Farms.

7. **D. emeritella** Stainton, race **alienella** Busck. Fore wing red-brown, dusted with white, with shaded, angulate, pale postmedial line, and white discal dot. Hind wing with red fringe.

The typical species occurs in Europe.

Caterpillar on Artemisia and presumably other aromatic Compositæ.

Oregon. New York: Ilion.

8. *INGA* Busck

(*Cryptolechia, Anesychia,* in part)

Closely similar to Depressaria; no pecten; abdomen cylindrical. Fore wing with Cu_1 and Cu_2 subparallel and strongly curved at base. No ocelli or maxillary palpi; labials long, upturned, and smooth. The black and white coloring is shared by *Depressaria canella.*

1. **I. sparsiciliella** Clemens. White; a black dot at base of costa and bar near base of inner margin, a squarish black spot near middle of costa, two black discal dots; black subterminal dots tending to run together. Hind wings and under side dark gray, head white with some black. 16 mm. (*contrariella* Walker, *atropicta* Zeller).

Southward this species flies in May and June.

New York to Texas. New York: West Farms.

9. *SEMIOSCOPIS* Hübner

(*Enicostoma,* in part; *Epigraphia* Stephens)

With ocelli. No distinct maxillary palpi. Labial palpi upturned in front of face, the second joint with indications of a bifurcated tuft toward the tip, the third shorter than in Depressaria and slender; tongue somewhat weak; no pecten. Fore wing with marked apex and oblique outer margin, Cu_2 more strongly curved than Cu_1. (The two are stalked in *S. inornata* [subgenus Epigraphia]). Of our species *S. megamicrella* also may be an Epigraphia, but I have no full notes concerning it.

The caterpillars are found on deciduous trees in the fall; the moths flying in the spring from April to June. *Agonopteryx allenella,* with but slightly flattened abdomen, forms the transition to this genus, but may be distinguished by its pecten and blunter wings.

Key to the species

1. Black longitudinal mark reaching base of wing.
   2. Line heavy, the basal part strongly curved, and running from extreme base of costa across Sc and R.....5. *packardella*
   2. Line more slender, running straight out in fold.....4. *aurorella*
1. Black mark, if present, not reaching base.
   2. A heavy irregular black bar over disc.....3. *merriccella*
   2. No definite black marking.
      3. With conspicuous black terminal dots, and dots on disc. 2. *megamicrella*
      3. Evenly powdery gray; terminal dots absent, and dots on disc diffuse. 1. *inornata*

1. S. inornata Walsingham. Powdery ash gray; outer half of fringe white with gray-stained tips; usual marks indicated by a slight irregularity of the dusting. Hind wing of the lighter ground color, the base of the fringe distinctly powdered. This species is easily confused with the next, but is apparently the only one which normally has Cu_1 and Cu_2 stalked.

Ottawa, Ontario; Pennsylvania; Manitoba. New York: Ithaca, Karner.

2. S. megamicrella Dyar. Whitish, powdered with light brown; a double antemedial black dot on cell and a distinct black lunated discal bar, in some specimens broken in the middle; a rather distinct series of dark subterminal dashes running parallel to outer margin. Hind wing nearly white, with a faint continuous pale gray line in base of fringe. Cu_1 and Cu_2 of fore wing may be stalked. 18–25 mm.

April and May.

Massachusetts to Ohio. New York: Ithaca; East New York, Long Island.

3. S. merriccella Dyar. Closely similar to *S. packardella*, but rather more distinctly striate, the black dash not reaching the base of the wing. 25–30 mm. (**H 48**:38.)

May.

New Hampshire to western Pennsylvania. New York: Big Indian Valley, Albany.

4. S. aurorella Dyar. Light gray, dusted somewhat irregularly with dull brown. Black basal dash fine, nearly straight, starting at base of costa, but running almost wholly in fold; its outer end attached to a curved line running up into cell, and often connected with the crescentic discal bar. Obscure dark dashes in the subterminal region, and a postmedial dash in fold. Terminal dots strong. Hind wing pale gray. 25–30 mm.

New York to Manitoba. New York: Ithaca, Big Indian Valley.

5. S. packardella Clemens. Gray, slightly streaked and dusted with brown. A heavy black bar running from base of costa out along base of **R**, then curving down into fold, and then up across cell to middle of costa. A slender branch running toward base of wing in fold, and a thicker one from where it crosses **R** to lower angle of cell; the latter bar convex outward. Hind wing pale gray. 25 mm.

June.

Northern Atlantic States. New York: Ithaca, Big Indian Valley, Albany.

10. *ETHMIA* Hübner

(*Psecadia* Hübner; *Anesychia*)

Moth similar to Semioscopis. Sensory area on antennæ more extensive, covering half the antennæ, even at the base. Palpus without any tufts on second joint. Fore wing (fig. 142) narrower, with Cu_1 and Cu_2 widely separated at origin and nearly straight. Hind wing with **R** often preserved, M_2 rather nearer

to M_1 than to M_3 and nearly straight. Caterpillar with a single band of biordinal hooks on prolegs; sometimes with additional setæ in group vii of abdomen; otherwise normal; alpha of prothorax nearer mid-dorsal line than beta. Pupa obtect, with 5–6 and 6–7 capable of dorso-ventral motion; flattened and rounded, without cremaster. Maxillary palpi large; labials minute; epicranial suture present, but fronto-clypeal absent; tongue not nearly as long as fore legs, middle legs separated on midventral line by fore legs; hind legs concealed by the antennæ, which lie in contact for their posterior third. Wing cases hardly extending beyond fourth segment of abdomen. End of body unarmed, rounded over. Anal prolegs preserved, provided with hooks, and taking the place of a cremaster; located on each side of the genital opening; apparently corresponding to the anterior group of hooks in Stenoma.

The peculiar larva of this genus (fig. 151), which is most closely matched in the Choreutis group, has caused some workers to place it in a special family, Ethmiidæ, of the Yponomeutoidea. The moth and pupa, however, are very close to the more primitive Œcophoridæ. The typical group feed on Boraginaceæ, enclosed in a light web.

Key to the species

1. Basal segment of abdomen blackish; the rest yellow, contrasting. 1. *fuscipedella.*

.1. Abdomen all gray.

2. Middle of wing broadly black from base to apex.

3. Expanse less than 20 mm., fore wing not streaked between veins. 2. *trifurcella*

3. Expanse 25 mm. or over; fore wing gray-streaked between veins. 3. *macelhosiella.*

2. No dark longitudinal stripe.

3. One short black dash in cell, and dot at lower angle....4. *longimaculella.*

3. Two dashes in cell, sometimes connected into a slender streak, and no dot .....5. *zelleriella.*

1. **E. fuscipedella** Walsingham. Mouse gray; head, thorax, except tegulæ, and base of abdomen, concolorous gray; the rest of abdomen and hind tibiæ, yellow, immaculate. Two black dots on thorax. A black dot in middle of cell, one or two at end, and antemedial dot in fold. Usually with strong black terminal dots. Hind wing concolorous, immaculate. 25 mm.

The larva should be sought for on Thalictrum.

North Carolina; Iowa; Nebraska; Manitoba.

2. **E. trifurcella** Chambers. White, thorax with a black central stripe and a dot on each side of it. Palpi annulate and tipped with black. Fore wing with a black median stripe from base to apex, either trifurcate at apex or much narrower and flanked by two black bars. With black terminal dots and two black dots near inner margin (at ¼ and ¾ way out on wing). Antennæ dark brown. 17 mm.

No authentic material is known of this species.

Kentucky.

3. **E. macelhosiella** Busck. White, lightly dusted with black; the black tending to form streaks between the veins, especially toward costa, ending in heavier terminal dots. A broad, irregular, and slightly diffuse black band from base to apex, crossing apical fringe, and nearly interrupted by a white bar at end of cell. Hind wing gray. Fringe paler. Thorax black and white. 25–28 mm.

Larva on *Phacelia* (Hydrophyllaceæ) at the beginning of May. With a tuft of hairs on wart vii of ninth segment of abdomen only, the rest of the body with the usual primary hairs. Head, tubercles, setæ, cervical and anal plates, true

legs, and plates on prolegs black. Dorsum of body dull black, with a whi mid-dorsal stripe, extending onto the cervical and anal plates; a broad whi lateral band, more or less suffused with pinkish and sometimes with yellow under side grayish white. Pupa formed in a gallery in dead wood or bark, th entire summer passed in the pupal stage. Pupa stout, somewhat flattened, dar brown; with the anal prolegs preserving their hooks and taking the place of cremaster; located on the ventral surface well before the end of the body. Mot emerging in September to November; and apparently hibernating.

Maryland; Missouri.

4. **E. longimaculella** Chambers. White, often slightly grayish. A black dot c vertex and front of thorax, and two on disc of thorax; two black annulations o third segments of palpus. Fore wing with a rounded black spot at end of ce and one below it and slightly farther out. Base of costal edge black; a stron black dash on outer half of cell below middle, and shorter one on base of **R**; als three at middle of wing below costa, one beyond cell, and one before middle c fold; rarely with the second dash in the cell, shown by the next species, trace able. Hind wing light gray. 22 mm. (*Hyponomeuta* Chambers).

Caterpillar in a very flimsy web on stoneseed (*Lithospermum*). Head dull black Body purplish black, cervical shield large, bright orange, bisected by a yellow line tubercles concolorous. Neck white; white or yellowish transverse bands behin second and third segments of thorax and fifth and sixth segments of abdomen, th anterior ones slender dorsally and expanded below. Feet all ringed with black Moth in May and July; larva in July.

New York to Kentucky. New York: Plattsburg, Ithaca.

5. **E. zelleriella** Chambers. Closely similar to *E. longimaculella*. A heavy black bar on base of costa, one toward base, and one in outer part of cell, obliteratin the discal dot; one in subterminal region opposite the last, larger than in *longi maculella*; and several streaks toward costa. 18 mm.

Caterpillar on *Phacelia dubia*, living almost completely exposed. Head black rounded, with a gray spot on upper part of front, and a rounded spot on each side, separated from the frontal spot by the black adfrontal sclerite. Tubercles of body, except vii, in large rounded velvety black spots; thoracic feet black prolegs white. Body white with diffuse yellow dorsal, and even less definite latera bands. Pro- and mesothorax and first segment of abdomen banded in front with black; smoky ventrally. Abdomen with rounded black dorsal spots on segment and smaller ones on incisures; with broad subdorsal gray shades, defined on lowe side, and joined by lateral oblique ones. Anal plate sooty. Caterpillar found in May; moth emerging the following April.

Montreal, Quebec to Wisconsin, and south to Texas; apparently rarer northward.

11. *SCHIFFERMUELLERIA* Hübner

(*Œcophora*, in part; *Callima* Clemens, not *Kallima* Westwood; *Epicallima* Dyar)

Palpi very long, recurved, smooth; second segment thickened, third slender shorter. Antenna without pecten; tongue developed. Fore wing rather narrow sublanceolate, with oblique outer margin, with all veins preserved, R_4 and R_5 stalked, both running to costa, the rest free, and Cu_2 nearly straight. Hind wings narrower, lanceolate but rounded at apex, with all veins preserved, M_2 rather nearer to M_3 than to M_1; M_3 and Cu_1 connate. Brilliantly marked species.

Key to the species

1. Dark brown with yellow patches.
2. Yellow scales or streak in base of fold.....(*Œcophora newmannella*).
2. Three or four rounded or irregular spots.....4. *dimidiella.*
2. A comma-shaped, or semilunate spot two-thirds way out on inner margin. 5. *coloradella.*

1. Tricolored.
2. Yellow with red-brown markings.....1. *argenticinctella.*
2. Mainly tawny yellow and black.
3. A longitudinal streak from before middle to apex.....3. *lucidella.*
3. This streak broken up; square cream-colored spots on costa and inner margin toward base.....2. *edithella.*

* *Eyes large. Cilia on antennæ half as long as segments* (Schiffermuelleria).

1. **S. argenticinctella** Clemens. Head pale; thorax orange; palpi brown and white; antennæ black and white. Fore wing orange and yellow; base of inner margin with a silvery band edged with black; an antemedial oblique bar, not reaching costa; a bar along costa, well out, and a semicircular one opposite it, on inner margin; all silvery and edged more or less fully with black. Base, apex, and area enclosed by the line, deep orange or chocolate brown. A brown spot at apex and some dark subterminal suffusion. Fringe pale. Hind wing fuscous. 12 mm.

End of June to August. Caterpillar under bark of elder.

Of general distribution and not very rare. New York: Ithaca, Rhinebeck, New York City.

** *Eyes small. Cilia on antennæ at least as long as segments.*

2. **S. edithella** Busck. Dark bronze brown, with golden and silvery markings, face white; palpi somewhat golden; antennæ bronzy black; vertex and thorax deep bronze; fore wing with a transverse, erect, silvery fascia at a fourth way out, widening somewhat on inner margin; and an apical fascia two-thirds way out, reaching the costa and interrupted at its middle by a golden streak; a fine, silvery, subcostal streak in median area, and two close together in middle of wing: all dark-edged. A longitudinal golden shade on and beyond cell, interrupted by the silvery markings. Fringe, abdomen, and hind wings dark bronzy brown, with silvery anal tuft. 9–10 mm.

Center Harbor, New Hampshire; Delaware Water Gap, Pennsylvania.

3. **S. lucidella** Busck. Palpi golden yellow. Antennæ black with silvery white tips. Head and thorax bronzy. Fore wing black on margins toward base, along dorsum, and around apical edge; the rest a yellow area, covering costal half of wing and sending a long process toward apex; a narrow, black-edged blue fascia a third way out, crossing the golden area and ending in a pale yellow discal spot. Two pairs of black-edged longitudinal streaks in cell; a small pale yellow spot at middle of costa; and a dash two-thirds way out. Fringe iridescent blackish. Hind wing, abdomen, and legs black; tips of tarsi and spurs silver white. 12 mm.

Early June.

Western Pennsylvania.

4. **S. dimidiella** Walsingham. Dull brown, spotted with straw yellow. Face white, antennæ black and white, with white scape. Fore wing with a very large yellow triangle resting on inner margin near base, and smaller spots on costa at middle and before apex, the latter spot continued as a curved yellow postmedial line to inner margin. 12 mm.

This moth can be superficially distinguished from *Œcophora borkhausenii* by its fringe and thorax being mostly black; from *Symmoca novimundi*, by its much more extensively pale head; and from *Triclonella determinatella*, by the basal spot not reaching the costa. It flies from the end of April till June.

Toronto, Ontario, and west to British Columbia and California.

5. **S. coloradella** Walsingham (variety). Smoky gray-brown, somewhat powde and dull. Some yellow on vertex and thorax; a half-lunate spot on inner marg extending a third way across the hind wing. (In the northern form there is narrow yellow dorsal edge extending from this spot to the base of the wing, an continued as a pair of streaks on the thorax.) 15 mm.

The typical form of this species occurs in Colorado and lacks the yellow dors streak. It is very close to *sulphurella*, the type of Œcophora; in fact all th species here listed, except *argenticinctella*, might well be transferred to that genu

My only date for this species is July 28.

Parry Sound, Ontario; British Columbia.

12. *DECANTHA* Busck

(*Œcophora*, in part)

Similar to Schiffermuelleria, but palpi not so long; antennæ with stron pecten; fore wing with R_4 and R_5 completely fused; hind wing with M_2 and C separate.

1. **D. borkhausenii** Zeller. Blackish with yellow thorax, rounded patches ne base and middle of fore wing; a less regular transverse subterminal bar, and smaller postmedial spot on inner margin; the spots more or less white-edge Fringe yellow, hind wing brown. 15 mm. (*boreasella* Chambers).

Caterpillar translucent white, with yellow-brown head, cervical shield, etc.; unde bark of pine, in June; the moth emerging in June and July.

Europe. Cohasset, Massachusetts; District of Columbia; Arizona; Britis Columbia. New York: Ithaca.

American specimens (*boreasella*) are aberrant, and may represent a distinc species.

13. *FABIOLA* Busck

(*Œcophora; Borkhausenia*, in part)

Similar to Borkhausenia, but lacking one radial vein. No pecten; palpi slende third segment nearly as long as second. Male antennæ with long cilia; tongu developed, M_3 and Cu_1 of hind wing connate.

1. **F. shalleriella** Chambers. Dark brown, broadly shaded with golden yellow but leaving the edges of the markings narrowly brown. A white antemedia fascia, broadening regularly to inner margin, erect, and with brilliant blu iridescence toward costa; three or four large, partly confluent, black spots i lower half of median area, each centered with a metallic blue spot. An erec blue subapical fascia across the wing, followed by a large cream-white spot o costa. Fringe dark brown, whitish at base toward anal angle; hind wing an body dark brown. 12 mm.

May southward, June in Pennsylvania.

New Jersey to western Pennsylvania and Georgia.

14. *ŒCOPHORA* Latreille

(In part; *Dasycera* Haworth)

Similar to Borkhausenia; no ocelli; eyes small; antenna thickened more or les with scales toward base, and heavily ciliate in male (cilia three times as long a segment); palpi smooth, maxillary palpi distinct; tongue weak, scaled to it tip. Fore wing broad toward tip and bluntly rounded; hind wing broad-lanceolate M_2 quite variable, often nearer M_1 than M_3 in both wings.

7. **Œ. newmannella** Clemens. Bronze-black; second segment of palpi yellow; yellow streak in base of fold and one near base of cell of fore wing. Antennæ purple-black, white-tipped. 15–18 mm.

The moth flies in June in the North, in May in North Carolina. It is generally distributed and not rare.

New York: North Elba, Batavia, Rock City (Cattaraugus County), Portage, Ithaca, Trenton Falls, Albany, New Windsor.

Typically, both yellow spots are large, being separated only by the black vein, and the terminal segment of the palpus is mostly yellow. I have seen a variety from North Carolina with only a narrow basal yellow streak, or, at most, a few yellow scales in the cell. This form seems also to have far less rough scaling on the male antennæ, which makes the ciliation appear longer.

15. *TRICLONELLA* Busck

Similar to Borkhausenia, except for the stalking of M_2 in the hind wing; M_2 arising from near middle of end of cell in fore wing.

1. **T. pergandeella** Busck. Ochre yellow; head brownish black with a very thin white line over eye; second segment of palpi with four broken silvery lines, and third segment with one in front. Fore wing with a minute black point in middle of cell. Outer two-fifths of wing purple-gray, the boundary edged with white, and running out on costa. A little white scaling on the gray. Fringe fuller, pale-tipped. Hind wing and abdomen fuscous. 15 mm.

The moth has been obtained in late June and late August. It hibernates in the imago. There are two or three broods. The caterpillar feeds on Desmodium, in a case made of two leaflets. It is black, with the head and anterior half of prothorax yellow; a black spot over the eye, and two on the vertex. There are a dorsal and two lateral yellow spots on the meso- and metathorax, small dots on the first three segments of the abdomen, and large patches on the fourth and fifth segments. When young, the larva is predominantly yellow. The cocoon is translucent and oval, and is suspended in a case of three leaflets. There appears to be a form of this species in Arizona.

District of Columbia.

2. **T. determinatella** Zeller. Deep purple brown; a large, antemedial yellow area, nearly as long as wide, and reaching both margins broadly, with straight outer boundary; and an oblique postmedial area half as large, touching only the costa. Fringe and body dark. 10 mm.

June.

Missouri to Louisiana and west.

16. *BORKHAUSENIA* Hübner
(*Œcophora*, in part)

Palpi moderately long, curved (but less so than in the preceding genera); second segment thickened but smooth, and third, in *ascriptella*, about as long. Tongue developed; pecten strong. Antennæ ciliated in male; the cilia long in *ascriptella*, which belongs to subgenus **Crossophora** Meyrick. Fore wing (fig. 143) lanceolate, normal; hind wing with all veins present, **R and M_1 parallel; M_3 and Cu_1 connate.**

1. **B. ascriptella** Busck. Straw yellow, sparsely dusted with black scales. Palpi light ochreous; fore wing with base of costal edge black; a streak or spot in cell and one at end of cell. Hind wing pearl white with yellowish fringe. Fore legs black in front. 10 mm.

The moth looks like a Tinea but is easily recognized by the smooth head. It has been taken from June to August.

New York to western Pennsylvania and District of Columbia. New York: Ithaca.

17. *ENDROSIS* Hübner

Palpi long, upturned, smooth; second and third segments equal; ant with large scape bearing a pecten. Fore wing with all veins present; lanceo normal. Hind wing with M_3 lost and M_2 connate or short-stalked with Cu_1 as strong as any vein, but close to base (fig. 145).

The genus seems transitional to the Blastobasidae, and in the past has also placed in the Elachistidæ. The larva appears to be as in the Blastobasidæ.

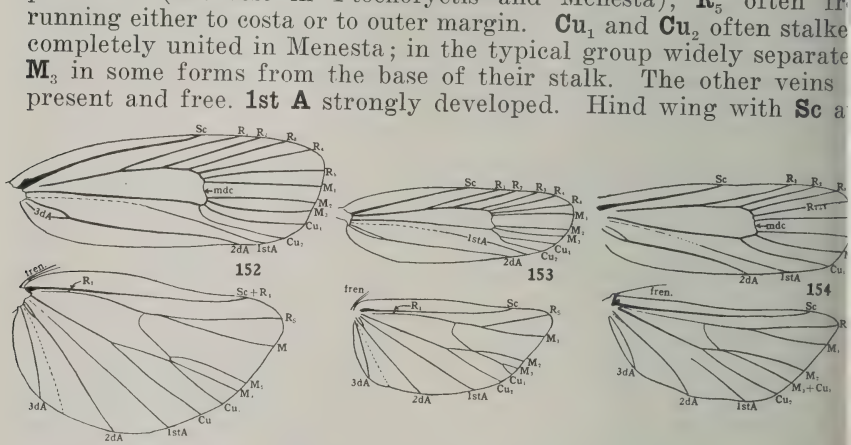
1. **E. lacteella** Schiffermüller. Dirty white, mottled and dusted with fusc Head, thorax, and extreme base of fore wing pure white, followed by a b fuscous band. Base, middle, and apex of costa also blackish. Three v blackish dots on disc,— in middle and at end of cell, and below and before first in fold. 15–18 mm.

A general household insect, feeding on fruit, fungi, meal, etc., Caterpillar yellov white with yellow-brown head and cervical shield. Injurious in Europe and the west coast of the United States. Only sporadic specimens have been repo from the East.

Family 20. XYLORICTIDÆ

(*Stenomidæ; Uzuchidæ*)

Head smooth. Palpi smooth and upturned to vertex or beyond, w second joint slightly thicker and squarely cut off. Thorax smoo scaled; hind tibiæ with loose hair. Fore wing typically with all radi preserved (one lost in Ptochoryctis and Menesta), R_5 often fr running either to costa or to outer margin. Cu_1 and Cu_2 often stalke completely united in Menesta; in the typical group widely separate M_3 in some forms from the base of their stalk. The other veins present and free. **1st A** strongly developed. Hind wing with **Sc** a



FIGS. 152–154. XYLORICTIDÆ

152, *Stenoma algidella*, venation; **153**, *Stenoma humilis*, venation; **154**, *Menes melanella*, venation

R connected by a more or less distinct cross vein (R_1); **R** and **M** long-stalked, the other veins normal; one medial lost in Menest Fore wing normally much more than twice as long as wide; shorter i Menesta and Setiostoma. Hind wing typically much broader, som times more than twice as broad.

Caterpillar with front less than half height of head; head held more less horizontally; adfrontals narrow, and not extending much ove front. Body with primary setæ only, above vii; vii represented 3 to 6 setæ. Thoracic legs adjacent, prolegs normal, short, each th a complete ellipse of bi- or triordinal hooks.

Ptochoryctis, with its case-bearing larva, and its multiple setæ on e prolegs, approaches the Lacosomidæ, but differs in lacking the char- teristic, rough, enlarged head, and swollen abdomen thicker in the iddle. The pupa of Stenoma is short and flattened, and has minute axillary palpi lying close to the antennæ. The clypeal suture is not stinct. The antennæ meet on the midventral line beyond the tip the tongue and then diverge again. The labial palpi are covered. ne ninth segment of the abdomen has a tuft of hooked setæ on the nter, besides the cremaster. In Menesta this tuft of setæ is on a dis- ct lobe.

The family divides into two well-marked groups, sometimes con- dered to be separate families. The Xyloryctinæ (Ptochoryctis), which re almost confined to the Old World, have R_5 running to the outer argin and long-stalked, and Cu_2 widely separated from Cu_1. heir larvæ are borers or case-bearers. The Stenominæ are found ostly in the New World; they have R_5 most often running to costa nd almost always free, and Cu_2 usually connate or stalked with Cu_1. heir larvæ are brilliantly marked and live exposed. The larva of one eotropical species bores in fruit. Besides the species here included n the family, some authors would add Strobisia, and perhaps other enera from the Gelechiidæ.

Key to the genera

1. Cu_1 and Cu_2 preserved, often stalked.
2. R_2 and R_5 long-stalked; R_1 lost ..... 4. **Ptochoryctis.**
2. R_4 and R_5 separate or hardly stalked; R_3 free.
3. Fore wing less than twice as long as wide ..... 2. **Setiostoma.**
3. Fore wing more than twice as long as wide ..... 1. **Stenoma.**
1. Cu_1 and Cu_2 completely fused; a radial also lost (fig. 154) ..... 3. **Menesta.**

1. *STENOMA* Zeller

(With *Ide* Chambers, *Brachiloma* Clemens, *Harpalyce* Chambers)

Palpi smooth, upturned beyond vertex; ocelli absent; male antennæ heavily iliate, without pecten. Fore wing about two and a half times as long as wide; osta arched, apex rounded, outer margin strongly convex, nearly erect and hort; inner margin more nearly straight. R_5 normally free and running to osta, in one of our species running to outer margin and connate or very shortly talked with R_4, which in all the United States species runs to the costa. M_1 and M_2 free, nearly straight; M_3 nearly straight, rarely arising from base of stalk of Cu. Cu_1 stalked, connate, or barely separate from Cu_2, varying somewhat n a single species. Cu_2 starting from cell or from Cu-stem almost perpen-

dicularly and then curving around parallel to Cu_1 and M_3; 1st A long. H wing much broader than fore wing, folded under it in the resting positi the wings rolled about the body. Hind wing with R and M_1 stalked, often v shortly; M_2 slightly separated from M_3, or shortly stalked when M_3 is lo stalked; M_3 stalked or connate with Cu_1, Cu_2 arising well back from end cell, and straight.

The genus is very large in South America, and varies enormously in struct as well as in pattern; but has not as yet been successfully divided. We h three main subgroups 1, *Stenoma* proper, with Cu_2 normally free in the f wing, M_3 and Cu_1 connate in hind wing, and white wings characteristically mark with gray; the thorax with a metallic posterior tuft; 2, *Brachiloma* Cleme (*Ide* Chambers) with Cu_1 and Cu_2 stalked, M_3 and Cu_1 of hind wing typically stalk and no metallic tuft; 3, a group containing *S. mistrella* Busck, with marked a and with R_4 and R_5 forking over it.

The caterpillar is as noted in family description. It has primary setæ only, a tubercle iv+v of the abdomen directly below iii. The pupa is described under t family.

Key to the species

1. White marked with gray.
   2. Larger; terminal line light gray, continuous, followed by black bars base of fringe.....1. *schlæge*
   2. Smaller; a series of black terminal bars on membrane, not preceded a fine gray line.....2. *algidel*
1. White, practically immaculate.....4. *vestal*
1. Gray with complex darker pattern.....3. *humil*
1. Not white; with darker discal dot only.
   2. R_5 to outer margin, apex marked.....8. *mistrell*
   2. R_5 to costa; apex often bluntly rounded.
      3. Ground light dull ochreous, with strong discal dot.....5. *unipunctell*
      3. Ground chocolate brown, hind wing cream, contrasting....6. *decorosell*
      3. Ground gray .....7. *querciell*

1. **S. schlægeri** Zeller. White; fore legs smoky; middle tarsi ringed with gra Fore wing with a double gray basal line from costa; a conspicuous, mixed gra and black, somewhat raised patch on inner margin from basal angle almost middle of fore wing, formed of more or less confluent waved bands; discal b gray, edged finely with white, and then broadly and irregularly with gray, a usually with a gray band running to inner margin; broad, even, pale gray pos medial and subterminal bands, and a very narrow terminal one cut into spot A black line, usually broken, in base of fringe; much more contrasting than t terminal line. Hind wing pale gray with white fringe. Thorax with prominer lead-colored posterior tuft. Male with simple curved uncus and very broad su scaphium broadly notched at tip. Fore wing with Cu_1 and Cu_2 usually connat separating at right angles; M_3 and Cu_1 of hind wing connate. 30 mm. (**H 48**:41).

General in distribution and not rare, in May and June. Caterpillar on oa New York: Mt. Marcy, Rock City (Cattaraugus County), Ithaca, McLean, Bi Indian Valley, Bethlehem, New Windsor.

2. **S. algidella** Walker. Very similar to *S. schlægeri*, with very little or n black toward base of inner margin, but in the northern form with a large gra patch. Terminal line broken into dots, dark gray and contrasting; dark do in base of fringe obscure, paler. Uncus of male with broadened bifid tip, su scaphium simple, slender, ending in a sort of beak. Cu_2 of fore wing well separate from Cu_1 (fig. 152) 15–23 mm. (*leucillana* of authors, not Zeller).

The distribution is general and the species is not rare in June and August. Th caterpillar is common on maple and various trees and shrubs, and has been foun

ring in an apple. It is not certain that this name is correctly applied to this ecies, but there seems to be no other available.
New York: Rock City (Cattaraugus County), Ithaca, Trenton Falls, Big Indian lley, Fort Montgomery.
3. **S. humilis** Zeller. Cu_1 and Cu_2 stalked in fore wing; M_3 and Cu_1 long stalked hind wing (fig. 153). No metallic tuft on thorax. Fore wing ash-gray, dusted d shaded with white. Three diffuse blackish spots on costa and two transverse sciæ resting on inner margin, the inner starting from a black dot in fold. ree dark dots in cell, the middle one not so intense. A faint curved dark sub-rminal line and a series of terminal dots. Hind wing browner than fore wing. mm. (*canusella* Chambers).
March to May; July and August.
Southern New Jersey, Missouri, and southward.
4. **S. vestalis** Zeller. White, with a few yellowish or black scales forming slight discal dot. Hind wing and under side slightly yellowish. 18 mm. *lbella* Chambers).
This moth is well known in the Southern States but may not exist in our rritory.
5. **S. unipunctella** Clemens. Straw color, dusted heavily and evenly with pale llow-brown, producing an effect of deep ochre; the dusting gathering to form dark discal dot. Cu_1 and Cu_2 stalked. Hind wing yellowish white. M_3 and Cu_1 nnate. 20 mm. (*lithosina* Zeller).
Maryland to Illinois, Missouri and southward. Larva on laurel oak.
6. **S. decorosella** Busck. Rich brown, rather like *S. unipunctella*, but more eply colored. Palpi brownish ochreous, with tip of second segment and base third whitish. Head paler, in some lights yellowish white; antennæ and orax light brown. Fore wing deep brown, silky; costal edge often showing e yellowish-white under side. Discal dot darker. Hind wing whitish fuscous; inge yellowish. 22–24 mm.
New Jersey; North Carolina.
7. **S. querciella** Busck. Antennæ as in *S. decorosella;* palpi whitish, second gment light gray on outer side. Thorax dark gray. Fore wing silky mouse-ay, slightly darker on fold, with two obliquely placed dark discal dots. Hind ing paler yellowish gray. 22–24 mm.
Caterpillar on oak in July.
New Jersey and Pennsylvania to Texas.
8. **S. mistrella** Busck. Fore wing dull light yellow-brown, slightly powdery. ith obscure dark discal dot and antemedial spot in fold, and obscure terminal ots. Hind wing dark gray with light brown fringe. R_4 and R_5 usually connate r slightly stalked, R_5 running to outer margin; hind wing with M_3 and Cu_1 per-eptibly separate. 18 mm.
Larva on timothy. Moth in July and September.
Western Pennsylvania to northern Illinois and Missouri.

2. *SETIOSTOMA* Zeller

Antennæ heavily ciliate; palpi very slightly thickened with rough scales, upturned eyond vertex, with third joint a little longer than second; no pecten. Legs dis-inctly tufted at spurs. Fore wing but little longer than wide, with Cu_1 arising ell before end of cell; Cu_2 at two-thirds way out on the cell; R_5 in some pecimens running to costa. Hind wing not large; M_3 stalked, rarely united ith Cu_1.
This genus was formerly placed in the Glyphipterygidæ, but is obviously Stenomid.
1. **S. xanthobasis** Zeller. Basal third of fore wing lemon yellow, with black osta and inner margin; the rest iridescent black, bounded by an iridescent blue ascia. Hind wing black. 12 mm.

July. Larva shaded with green and crimson. Head, cervical shield, and t legs pale brown; a dark spot on center of head; cervical shield narrow; a plate brown. Larva in a nest about 2 cm. in diameter, formed by an oval v of silk between two slightly separated leaves; feeding on the lower parenchy only. On *Quercus stellata* and related species, in May.

Massachusetts to Florida.

3. *MENESTA* Clemens

(*Hyale* Chambers; *Strobisia,* in part)

Male antennæ heavily ciliate; palpi smooth, second segment thickened, th a little shorter; fore wing (fig. 154) twice as long as wide, with square ou margin; 10 veins, all separate; R_4 and R_5 united, one dorsal vein absent, 1st well developed. Hind wing slightly broader, M_2 absent, R and M_1 stalked, M_3 a Cu_1 connate.

This is an aberrant and isolated genus, with the superficial appearance, genita and pupal characters of the Stenoma group. The preservation of 1st A in imago also shows that it belongs rather in this neighborhood than among Gelechiidæ, where it is commonly placed.

Key to the species

1. A large white costal spot.....2. *melanel*
1. A minute costal point or none.
2. Fringe white-tipped at apex.....3. *albaciliel*
2. Fringe not white-tipped.....1. *tortriciformel*

1. **M. tortriciformella** Clemens. Black-brown, with a purplish hue; head a antennæ deep yellowish fuscous; face pale below; palpi fuscous, whitish towa base. Fore wing with a small lunate white spot, convex outward, at end of ce fringes and hind wing fuscous; feet pale. 9 mm. (*liturella* Walker, *corylie* Chambers.)

Caterpillar white; on hazel, in September and October; under a thin silk web placed in the angle between a vein and the midrib, on the under side of leaf. Pupa in a cocoon formed by crumpling up this web. Moth in April.

Massachusetts to Kentucky.

2. **M. melanella** Murtfeldt. Shining black; face, palpi, under side, a spot metathorax; a large spot on costa of fore wing at middle, and apical half fringe, pure white. 8 mm.

Caterpillar with the same habits as *M. tortriciformella;* on oak. Moth May and August.

Virginia; Kentucky; Missouri.

3. **M. albaciliella** Chambers. Purple-black; face, most of palpi, under side, small and variable irregular spot at end of cell (usually a short discal streak and outer half of fringe except at anal angle, contrasting white; thorax whol black. 9 mm. (*argenticiliella* Chambers,— *lapsus calami, Strobisia* Chambers.)

Caterpillar with the same habits as the other species; on under side of blac berry leaf, in June; skeletonizing the leaf and later eating holes through it. Tv broods; moth in July and in early spring.

New York to Pennsylvania and Ohio. New York: Peru.

4. *PTOCHORYCTIS* Meyrick

Fore wing with 11 veins, R_3 and R_{4+5} stalked, both running to costa. Cu_2 aris ing from cell four-fifths way out, straight; M_3 and Cu_1 short-stalked. Hind win hardly broader, with seven veins; M_{2+3} and Cu_1 connate; R and M_1 connate. Ocel

sent; male antennæ bipectinate, without pecten on scape. Larva a case-arer on evergreens, with six setæ on prolegs; flattened, widest at first segment abdomen; setæ iii of spiracle-bearing segments with a double annular tubercle, parently movable. Pupa in the cocoon.

1. **P. tsugensis** Kearfott. Silvery white, veined with gray; with a narrow ter-nal gray shade immediately preceded by a blackish line. Hind wing yellowish ite. 21–24 mm.

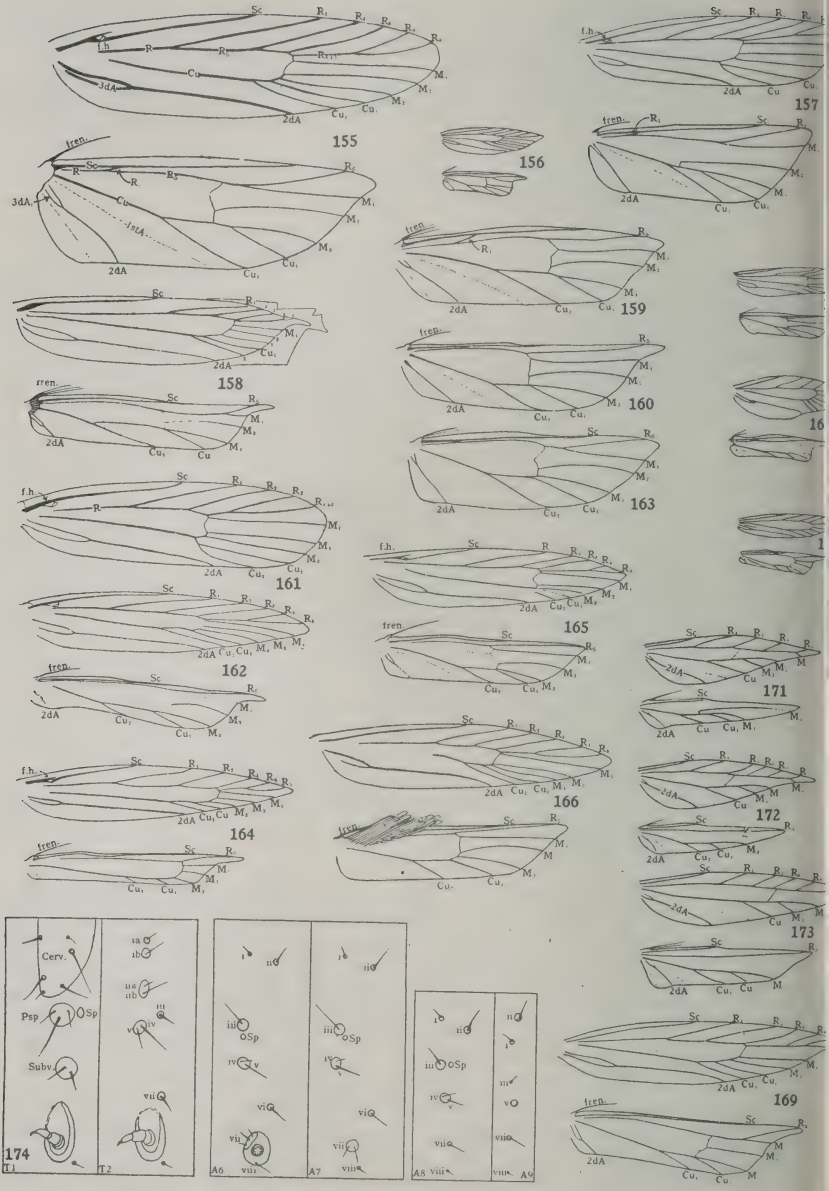
Larva on Tsuga (Japanese hemlock); cream-white, speckled with pink, with ckish head and cervical shield; in a case covered with needles and frass.

New Jersey. Introduced from Japan (?)

Family 21. GELECHIIDÆ

Moderately small moths, sometimes minute. Head typically noothly scaled, clothed with long scales curving forward and down, nd sometimes ruffled. Labial palpi normally as described for the perfamily; second joint often with a triangular tuft. The third int rudimentary in male of Anarsia only. Antennæ as in Œcophor-æ; very rarely with pecten (Sitotroga, Symmoca ?). Fore wing arrow, with rounded, rarely caudate (fig. 158) outer margin. R_5 nning to costa, stalked, or, rarely, completely fused with R_4; R_3 sually free; M_1 from near upper angle of cell or stalked with R_5; Cu_1 nd Cu_2 often stalked, never very widely separated; the other veins ostly free, and hardly ever with more than one vein lost. M_2 arising earer **Cu**-stem than **R**-stem. **1st A** absent (except the extreme tip some exotic Symmocas); **2d A** strongly forked at base. Hind ing more or less trapezoidal, the outer margin more sharply bent ver M_3 and Cu_1 and often concave above, or with projecting apex; arely bifid; lanceolate in some Helices. **Sc** and **R** connected by a ell-developed R_1 near base; R_1 and base of R_s both lost in Helice; and M_1 approximate at origin or stalked, except in a few genera ith markedly concave outer margin; M_2 various; M_3 and Cu_1 connate r stalked, rarely separate. **1st A** lost, and **3d A** very weak. M_1, or M_2, or both, sometimes disappearing in forms with concave outer argin; and M_3 rarely fused with Cu_1.

Larva (fig. 174) typical of the superfamily, as a rule; coxæ often a ttle separated, but by less than their width; adfrontals reaching nearly r quite to vertex; and front two-thirds as far, or ending in an attenu-ted point; prolegs almost always with biordinal hooks, either in an llipse or in two transverse bands; in the latter case with two groups n anals. Second, third, and fourth ocelli not distinctly grouped. Pro-gs lost and true legs rudimentary in a few genera. Pupa with clypeal uture complete and usually straight; labial palpi concealed, or show-ng a small triangle next to labrum; femora concealed. Antennæ con-iguous for some distance behind tongue, and then again diverging efore apex; maxillary palpi present and usually large, reaching from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FIGS. 155–174. GELECHIIDÆ

155, *Gelechia lugubrella,* venation; **156,** *Stomopteryx tæniella* (Europe), venation; **157,** *Trichotaphe fernaldella,* venation; **158,** *Polyhymno luteostrigella,* venation (the outline of the apical part of the fringe is also shown); **159,** *Gnorimoschema gallæsolidaginis,* venation of hind wing (typical of the normal group of the genus); 160, *Gnorimoschema scutellariæella,* or a closely related species (typical of the reduced group of the genus); **161,** *Glyphidocera* species, venation of fore wing; **162,** *Evippe leuconota,* venation; **163,** *Telphusa longifasciella,* venation of hind wing; **164,** *Aristotelia disconotella,* venation; **165,** *Paralechia pinifoliella,* venation; **166,** *Glauce pectenalœella,* venation (figured from a specimen from Rock City, New York); **167,** *Recurvaria leucatella* (Europe), venation; **168,** *Chrysopora eppelsheimi* (Europe), venation; **169,** *Epithectis subsimella,* venation; **170,** *Metzneria carlinella* (Europe), venation; **171,** *Theisoa constrictella* ♂, venation (after Braun); **172,** *Theisoa constrictella* ♀, venation (after Braun); **173,** *Theisoa pallidochrella* ♀, venation (after Braun); **174,** *Dichomeris verbascella* (Europe), seta map of larva

antenna to tongue. Cremaster present and sometimes with some hooked setæ on venter of ninth segment of abdomen as well.

The family is probably the largest of the Tineid series, and is especially developed in the tropics. Most of the subordinate groups are widespread, but the forms with a pecten are of Old-World affinity, and the Strobisia type is South American, like the Stenoma group of Xyloryctidæ, which they resemble.

Key to the genera

Moth

1. Fore wing with M_1 stalked with R_5 beyond origin of R_4, which is distinct (fig. 170).
   2. Pecten present ..... 29. **Sitotroga.**
   2. No pecten.
      3. Fore wing with a vein absent.
         4. R_1 absent, the first developed radial arising from cell close to end. 32. **Agnippe.**
         4. A dorsal vein absent; R_1 from cell two-thirds way out. (figs. 171, 173)
            5. Hind wing with R or M_1 lost ..... 34. **Helice.**
            5. Hind wing with R and M_1 connate ..... 33. **Stereomita.**
      3. Fore wing with all veins preserved.
         4. Hind wings with M_3 and Cu_1 widely separate (fig. 170).
            5. Second joint of palpus with long spreading hairs or a triangular tuft 31. **Ptycerata.**
            5. Second joint of palpus rough-scaled; expanse over 12 mm. 30. **Metzneria.**
            5. Second joint of palpus not very rough; expanse under 12 mm. 19. **Glauce.**
         4. Hind wings with M_3 and Cu_1 connate, stalked, or barely separate (fig. 169).
            5. Hind wings with M_1 absent (R-stem apparently simple) (fig. 162). 28. **Evippe.**
            5. Hind wings with M_1 present, attached to R-stem.
               6. Fore wings with M_3 and Cu_1 stalked ..... 27. **Trypanisma.**
               6. M_3 not stalked with Cu_1.
                  7. Second joint of palpus with a long, expansible tuft on inner side ..... 25. **Eucordylea.**
                  7. No such tuft.
                     8. R and M_1 of hind wing approximate at base .... 24. **Recurvaria.**
                     8. R and M_1 stalked ..... 26. **Epithectis.**

1. Fore wings with M_1 arising from cell, or more shortly stalked than R_4 (or with R_4 absent).
   2. Cu_1 and Cu_2 stalked (fig. 157).
      3. Second joint of palpus with a long triangular tuft below. 9. **Dichomeris,** 11. **Anorthosia.**
      3. Second joint of palpus without such a tuft; sometimes broad-scaled on both sides.
         4. Hind wings narrower than fore wings ..... 12. **Strobisia.**
         4. Hind wings broader than fore wings.
            5. Fore wings with 11 veins (R_5 united with R_4 as shown in fig. 161). 10. **Glyphidocera.**
            5. Fore wings with all veins present; R_4 and R_5 stalked.
               6. R_3 shortly stalked with R_{4+5} ..... 8½. **Brachmia.**
               6. R_3 free ..... 8. **Trichotaphe.**

2. Cu_1 and Cu_2 arising from cell separately.
3. Fore wing with one vein lost; M_3 and Cu_1 stalked.....6. **Untomia.**
3. Hind wings only, with one vein (**M**) lost (fig. 168).....23. **Chrysopora.**
3. Both wings with all veins present.
4. Hind wing with **R** and M_1 parallel, or not more than twice as far apart at tip as at origin.
5. Hind wings with M_3 and Cu_1 separate.
6. Costal margin of fore wings concave before apex.....22. **Enchrysa.**
6. Costal margin of fore wings normal.
7. Fore wing smooth-scaled; hind wing with **R** and M_1 parallel; M_2 distinctly nearer to M_1 than to M_3 (fig. 164)....21. **Aristotelia.**
7. **R** and M_1 of hind wing divergent; M_2 nearer M_3 (fig. 166).
8. Fore wing with raised scale tufts; ground nearly white. 17. **Arogalea.**
8. Fore wing not tufted; ground dark gray.....19. **Glauce.**
5. Hind wings with M_3 and Cu_1 connate or stalked.
6. Hind wings with large costal hair-pencil.....4. **Phthorimœa** (male).
6. Hind wings without hair-pencil.
7. Second joint of palpus with divided scale-ridge, third joint thickened with scales toward base.
8. Thickening of third joint, of appressed scales; fore wings normally without black, white-tipped scales; larvæ on Solanaceæ .....4. **Phthorimœa** (female).
8. Thickening of third joint reaching nearly to apex, leaving a short fine apex; fore wing usually with a large proportion of finely white-tipped scales; larvæ almost always on Compositæ .....3. **Gnorimoschema.**
7. Second joint of palpus without divided brush; third joint thin. 16. **Paralechia.**
4. Hind wings with **R** and M_1 approximate, connate, or stalked at origin (figs. 155, 163).
5. Hind wings with M_3 and Cu_1 separate (fig. 163).
6. Second joint of palpi with projecting tuft.....20. **Autoneda.**
6. Second joint of palpi without such tuft.
7. Male normal; M_1 of fore wing free or barely stalked with R_{4+5}. 18. **Telphusa.**
7. Male with large tuft on costa of hind wing; M_1 often stalked almost out to origin of R_4.....19. **Glauce.**
5. Hind wings with M_3 and Cu_1 connate or stalked (fig. 155).
6. Terminal joint of palpi short, concealed.....7. **Anarsia** (male).
6. Terminal joint of palpi about as long as second.
7. Second joint of palpus with large triangular tuft. 7. **Anarsia** (female).
7. Second joint of palpus rough-scaled beneath, often with divided brush .....2. **Gelechia.**
7. Second joint of palpus smooth-scaled.
8. Hind wing with outer margin sinuate, concave below apex.
9. Fore wing not caudate.
10. Hind wing with R_1 and M_1 approximate.....13. **Duvita.**
10. Hind wing with **R** and M_1 stalked.....14. **Stomopteryx.**
9. Fore wing candate (fig. 158).....15. **Polyhymno.**
8. Hind wing somewhat trapezoidal, but with outer margin not concave below apex.
9. Hind wing much broader than fore wing, **R** and M_1 approximate .....5. **Anacampsis.**

9. Hind wing hardly as broad as fore wing.
10. R and M_1 long-stalked.....1. **Symmoca**
10. R and M_1 connate or approximate; M_2 and M_3 very widely separated at margin.....13. **Duvita** (*conclusella*)

Key to known genera

Larva (Fracker)

1. No prolegs.
2. Body swollen and strongly tapering to ends (in burdock heads). **30. Metzneria**
2. Body nearly cylindrical (on dried grain).....29. **Sitotroga**
1. Prolegs present.
2. A complete circle of hooks.
3. Seta iii of eighth segment of abdomen in front of spiracle (rarely obliquely above it); setæ large, body striped.
4. Seventh and eighth segments of abdomen both with setæ ii farther from mid-dorsal line (and from its mate), than i.....17. **Arogalea**
4. Seventh segment of abdomen with seta ii closer to mid-dorsal line than i, eighth segment normal.
5. Triangle formed by fourth, lower, and posterior ocelli, with a right angle at the fourth; pattern wholly of transverse stripes. **18. Telphusa**
5. Triangle formed by the three lower ocelli with an acute angle at fourth; the posterior as near the lower as the fourth; pattern usually partly or wholly of longitudinal stripes. **24. Recurvaria, 2. Gelechia**
3. Seta iii of eighth segment of abdomen above, usually directly above spiracle; body pale, not striped.....5. **Gnorimoschema, 4. Phthorimœa**
2. Two transverse bands of hooks, spiracle of eighth abdominal segment very large .....9. **Dichomeris**

Key to the genera

Known pupæ (Mosher)

1. Body-setæ strong, often as long as a segment, and truncate at tip; second, third, and fourth segments of abdomen each with a subdorsal projection at its anterior edge and edged in front with a fringe of whitish hairs; and behind this with a prominent hump tipped with a similar fringe of setæ. Clypeal suture strongly curved forward; cremaster always present.
2. Movable segments of abdomen each with a pit with chitinized edges, on mid-dorsal line at front edge.....8. **Trichotaphe** (*flavocostella*).
2. No such pit; a deeply punctate band, followed by a groove, a band of short spines, and a strong ridge.....9. **Dichomeris**
1. Body setæ not modified; second to fourth segments not as described in the alternative.
2. Pupa densely covered with white setæ.
3. Maxillary palpi reaching tongue, antennæ broadly in contact on middle line; cremaster short and blunt, with hooked setæ at tip..5. **Anacampsis**
3. Maxillary palpi not reaching tongue; antennæ meeting at a point only; cremaster sharply curved at tip, with spines on sides. **21. Aristotelia** (*salicifungiella*).

2. Pupa not setulose.
3. Seventh segment of abdomen with a dense fringe of setæ on some portion.
4. The fringe on the front and sides of a prominent lateral cavity only.
5. Body smooth, not depressed; front edge of cavity trilobed..28. **Evippe.**
5. Body strongly depressed, spinulated; front edge of cavity bilobed. 18. **Telphusa.**
4. Fringe extending around the segment or nearly so.
5. Fringe extending around the segment in a straight line; body smooth and not depressed.....24. **Recurvaria** (*apicitripunctella*).
5. Fringe extending around in a wavy line; body depressed; surface with punctures or spines.
6. Fringe edging two very large lobes on dorsal surface; last three segments of abdomen tapering.....27. **Trypanisma.**
6. Fringe not edging two lobes; last three segments not tapering. 2. **Gelechia.**
3. Seventh segment without a fringe of setæ.
4. Cremaster with short projecting spines.
5. One spine on mid-dorsal line; clypeal suture nearly straight. 4. **Phthorimœa.**
5. An additional spine on each lateral margin; clypeal suture strongly curved forward .....29. **Sitotroga.**
4. Cremaster with curved or straight setæ.
5. With hooked setæ.
6. Antennæ reaching tips of wings; divergent at tips, uncovering tips of legs.
7. Five pairs of long curved setæ; body slightly truncate at anterior end .....24. **Recurvaria** (*variiella*).
7. Two pairs or less of long curved setæ, front end of body rounded. 21. **Aristotelia** (*physaliella*).
6. Antennæ not reaching caudal end of wings, nor diverging at tips. 3. **Gnorimoschema** (*lavernella*).
5. Short straight setæ only.....3. **Gnorimoschema** (*gallæsolidaginis*).

1. *SYMMOCA* Hübner

(*Œgoconia* Stainton)

No ocelli; head normal; antennæ subserrate; palpi with second segment long; smoothly but densely scaled below; third long, thin, and acute; wing form about like that of Œcophora, but hind wing very slightly trapezoidal; fore wing with R_5, in our species, running to costa, Cu_1 and Cu_2 free in the American species; hind wing as wide as fore wing, R and M_1 stalked, in *S. novimundi*, halfway to apex; M_3 and Cu_1 connate; 1st A distinct in both wings. Larvæ hardly known, apparently feeding on lichens. This is a primitive genus, transitional from the Œcophoridæ, and by some authors associated with them. Our species is an *Œgoconia* and very near to *S.* (*Œ.*) *quadripuncta* Haworth.

1. **S. novimundi** Busck. Dark fuscous; second joint of palpus dark brown, with yellow inner side and apex; extreme tip of third ochreous. Face, tips of tegulæ, and two small posterior dots on thorax, ochreous. Fore wing with three ochreous costal spots, the one at end of cell largest; sometimes these spots are lengthened into irregular bands, and sometimes there is a fourth on inner margin opposite the last costal. Hind wing and anal tuft lighter. 12–13 mm.

August and September.

Montclair, New Jersey; Roxborough, Pennsylvania.

2. *GELECHIA* Hübner

(*Cirrha* Chambers; *Œseis* Chambers; *Pseudochelaria* Walsingham; *Teleia* Heinemann; *Lita* Treitschke)

Palpi with second joint rough-scaled; most often with a divided brush or tuft which is sometimes very large; third smooth, more slender than in Gnorimoschema. Fore wing (fig. 155) normal, oblong or pointed, variable in breadth; M_3 and Cu_1 sometimes stalked in *G. bosquella*; hind wing never much narrower and usually rather broader than fore wing, typically trapezoidal, strongly sinuate below apex in subgenus Lita; R and M_1 sometimes stalked, M_3 and Cu_1 connate or short-stalked; M_2 approximate to M_3.

Œseis Chambers includes the species with very heavy palpal tuft; **Teleia** those without ocelli, and otherwise normal. This is a somewhat heterogeneous genus, which should be subdivided. It includes forms transitional to several other genera, notably Anacampsis, Gnorimoschema (or rather, the primitive aberrant Gnorimoschemas which are themselves transitional to Phthorimœa) Telphusa, and Duvita.

Key to the species

1. Ground color black (or dark brown or gray, with contrasting pale markings).
   2. Inner margin yellow to rust red.....10. *bosquella.*
   2. With white or whitish markings only.
      3. Head pure white.
         4. White markings diffuse.....7. *continuella.*
         4. White markings clean-cut.
            5. Two white fasciæ and a triangular spot between them....9. *viduella.*
            5. One incomplete fascia and several spots.....1. *cercerisella.*
      3. Head more or less mottled or dark.
         4. A white oblique streak or fascia from costa a third way out.
            5. A fascia also at two-thirds way out.
               6. A triangular white spot at middle of costa.....9. *viduella.*
               6. No spot at middle of costa.....8. *lugubrella.*
            5. No fascia two-thirds way out.....2. *coloradensis.*
         4. No such streak.
            5. An angulate white fascia at apical third.....6. *bimaculella.*
            5. No such fascia.
               6. A white posterior spot on thorax.....3. *argentipunctella.*
               6. No white spot on thorax.
                  7. Second segment of palpus white or yellow.
                     8. Ordinary spots white.....4. *trialbamaculella.*
                     8. Ordinary spots black, hardly visible.....4½. *psiloptera.*
                  7. Second segment of palpus dark.....5. *confusella.*
1. Ground color not black or blackish with pale markings.
   2. A contrasting brown-black bar or patch at basal angle.
      3. An oblique light bar a third way out; patch larger.....30. *walsinghami.*
      3. No such bar; patch smaller.....31. *pennsylvanica.*
   2. No black patch at basal angle.
      3. A black or contrastingly dark oblique bar running to costa near base; the ground before it pale fuscous, luteous, or cream white.
         4. Bar diffuse on outer side; no decided outer fascia....29 *mediofuscella.*
         4. Bar sharply defined on outer side; a similar black postmedial fascia.
            5. Outer margin heavily edged with powdery black; the orbicular a black point, well separated from the outer fascia..28. *pseudofondella.*
            5. Outer margin without definite black border; orbicular large and fused with outer fascia, or at least with reniform.....27. *fondella.*

3. No black antemedial oblique fascia running to costa; or else with ground powdery gray to base, and fascia diffuse.
4. Ground dominantly luteous; pale moths.
5. Ground very slightly mottled, with three to six black dots. 35. *branella.*
5. Streaked with a darker shade of light gray.....34. *arenella.*
5. Dusted and mottled with yellow-brown and black; tending to diagonal markings .....33. *nundinella.*
4. Ground dark, or so heavily dusted as to appear dark gray.
5. Dorsum of thorax luteous, contrasting with the blackish tegulæ.
6. Sides of disc of thorax and third joint of palpi black. (12). *ochreostrigella.*
6. Disc of thorax wholly yellowish white; palpi yellow, banded with black .....12. *hibiscella.*
5. Dorsum of thorax evenly colored, or nearly so, dorsal half of fore wing not contrastingly pale.
6. Outer discal dot black, ocellate with white or yellowish. 13. *discoocellella.*
6. Outer discal dot not ocellate, or else with the center pale.
7. Fore wing markedly darker-streaked on the veins, at least outwardly, and not notably powdery.
8. Stripes black on luteous, and fine in the cell. 10. *ochreosuffusella.*
8. Stripes blackish on fuscous brown, not contrasting; usually with a thick bar in outer part of cell.....11. *fluvialella.*
7. Not dark-streaked on veins; ground often powdery.
8. A large part of scales with fine black tips and longitudinal lines on a gray base, producing an almost evenly gray effect; the wing under a lens apparently more finely powdered than usual .....13. *anarsiella.*
8. Scales mostly unicolorous, or broadly black- or white-tipped.
9. Crisply powdered with black or dark gray on light blue-gray or white; often white-shaded toward costa; or with broad areas of light bluish-gray.
10. A contrasting blackish longitudinal dash in outer part of wing .....(35) *sequax.*
10. No such marking.
11. Antemedial line represented by two fine strongly outwardly oblique lines to costa, contrasting when costa is whitish; very obscure or even obliterated when costa is dark brown.
12. Costa heavily shaded with whitish; larva on Robinia. 25. *pseudoacaciella.*
12. Costa concolorous, or brown; larva on Prunus. 26. *serotinella.*
11. Antemedial line nearly transverse and thick; rarely absent.
12. Postmedial line whitish, contrasting, nearly straight (small species) .....32. *tephriasella.*
12. Postmedial strongly bowed out in middle, when distinct.
13. Second segment of palpi solid black, except extreme tip; tuft in fold preceded by a well-marked yellow bar; ground suffused with blue-gray except at costa. .....23. *nigrimaculella.*

13. Second segment of palpus powdery gray; tuft in fold blackish, preceded by a few yellow scales at most; wing with strong contrasts.
14. Moth whitish, the markings formed of black powdering on a white base, without any gray; a distinct, outwardly oblique median fascia. 17. *lynceella.*
14. More or less gray or fuscous scaling; the effect less whitish.
15. Scutellum contrasting, light yellow. 19. *maculimarginella.*
15. Scutellum concolorous, powdery gray. 18. *bicostomaculella.*
13. Second segment of palpus and whole wing nearly evenly powdered black on blue gray. 15. *inquilinella.*
13. Second segment of palpus contrasting, yellowish white. ..... 20. *vernella.*
9. Fuscous, nearly even or obscurely dusted and shaded.
10. A heavy but irregular black antemedial bar.. 21. *dyariella.*
10. No such marking.
11. Heaviest black spots are first discal dot (orbicular), which is a bar, and antemedial dots on costa and in fold ..... 24. *gilvomaculella.*
11. Outer discal dot most strongly marked, or the discal spots obsolete.
12. Second segment of palpus deep black.
13. Fore wing with indistinct white markings. 14. *albisparsella.*
13. Fore wing with faint dark markings only. 16. *unctulella, rileyella.*
12. Second segment of palpus powdery gray.[18] 11. *fluvialella,* etc.

1. **G. cercerisella** Chambers. Velvety black; palpi, head, and collar white; third segment of palpi white except at base; antennæ dark. Fore wing with a few ochreous scales, slightly bronzed; three costal spots, the first reaching fold, the second and third on inner margin; and some white terminal points. Costal cilia brown, dorsal white, with a brown line at base. Hind wing pale drab, faintly pink tinged. 14 mm.

Two or more broods. Moth from May to September. Caterpillar on *Cercis canadensis,* spinning the leaves together; white, a broken black band on face and a bowed one on vertex; posterior half of each segment above, and true legs black. Young larva wholly white; sometimes living in a single folded leaf.

Distribution general, north to central Illinois and Maryland.

2. **G. coloradensis** Busck. Deep black; antennæ black; second joint of palpi white with dark scales above; third mostly black with white tip. Face white; fore wing with an oblique antemedial costal streak reaching to fold, an elliptical white spot on disc, an angulate costal spot at beginning of fringe, a dorsal spot

[18] *G. fluvialella* will run to the last alternative of the key if the darker veining, which is often obscure, is not noted. Its large size and broad wings distinguish it from most of the plain Gelechias. *G. discoocellella* will also run there, in the case of specimens that have lost the black dot in the reniform. It may be distinguished by its purplish overcast and pale, dot-like reniform. There are several other smallish species which have never been worked out.

opposite the last, and one less than halfway out on fold. A few white scales near apex. Hind wing dark fuscous. 15 mm.

May.

New Jersey (Benjamin) to Colorado, south to Florida.

3. **G. argentipunctella** Ely. Purple-black; antennæ with a yellow ring at end of scape, second joint of palpus flecked with white, and white in front; third joint white at base and tip. Thorax with a white posterior tuft; fore wing with a white costal spot two-thirds way out with black before it; two black, white-shaded, discal spots, and a third before them in the fold. Abdomen dark, legs with yellow annulations. Hind wing with fringe and hind tibial tuft yellowish; a large yellow pencil on hind wing of male. 17 mm.

July.

East River, Connecticut.

4. **G. trialbamaculella** Chambers. Black-brown. Second segment of palpus and face yellow. Fore wing with small white spots opposite each other two-thirds way out, and several minute white points, mostly in cell and fold. Hind wing light fuscous. 15 mm.

Caterpillar on many shrubs (locust, oak, Comptonia, Epigæa, Vaccinium) in a nest between two leaves, forming a frass tube, open at both ends, and skeletonizing the leaves. Caterpillar dirty yellow, with head, cervical shield and six longitudinal stripes darker yellow. Moth emerging in late July and early August.

I have specimens from Virginia in May and Massachusetts in June, indicating an early brood.

Maine to Virginia and Missouri. New York: (Beutenmüller).

4½. **G. psiloptera** Barnes and Busck. Black-brown, the head and thorax with a purplish sheen, and fore wings with contrasting yellow scale-bases visible under a lens. Second segment of palpus yellow, dusted with black; third segment black with a few yellow scales. Fore wing with ordinary spots black; almost invisible; fringe blackish fuscous. Hind wing blackish fuscous with somewhat paler fringe. 16–17 mm.

Meach Lake, Laurentians, Quebec. New York: Peru (variety).

5. **G. confusella** Chambers. Similar, face whitish below only; palpus dark, lightly dusted with white; fore wing with postmedial dot in fold. 15–18 mm. (*persicœella* Murtfeldt).

Larva on peach.

Michigan.

6. **G. bimaculella** Chambers. Dark purplish brown or black; extreme tip of palpus yellowish white; a white spot beyond middle of wing and a bar from base of costal fringe, not reaching inner margin. 12 mm. (*ternariella* Zeller, *sylvœcoella* Chambers).

Locally common.

New Jersey; Kentucky; and Texas.

7. **G. continuella** Zeller. Blackish gray, dusted with white, the white tending to form a couple of oblique bands; the large black discal dots more or less ringed with white or with the space between them white; normally with a white spot in fold beyond the first fascia, costal and dorsal ones opposite each other at beginning of fringe, a small spot at apex, and a couple on margin below. Hind wing with R_5 and M_1, M_3 and Cu_1 stalked. 18–19 mm. (*trimaculella* Packard, *albomaculella* Chambers).

July.

Labrador; Europe. New York: Lake Tear (Mt. Marcy), Ithaca.

8. **G. lugubrella** Fabricius. Black, face and second segment of palpus white. Fore wing with an antemedial white fascia, running to fold, and a postmedial fascia crossing the wing, less oblique than outer margin, and more or less constricted at middle. 15 mm.

June.

Circumpolar; south to Maine, northern New Jersey, and Manitoba. New York Peru.

9. **G. viduella** Fabricius. Black, amount of white on head variable; sometime with white on thorax also. Antemedial fascia as in *lugubrella*, postmedial pa allel to outer margin, and often interrupted for a very short distance at middl Fringes white-tipped. Typically with the white covering about a fourth of th wing surface; in var. **labradoriella** Clemens covering about half. 15 mm.

July.

Circumpolar; south to Mt. Washington, New Hampshire, and Alberta.

10. **G. bosquella** Chambers. Thorax and fore wing rich chocolate brown, fac yellowish white; antennæ brown with extreme tip of scape white; palpi dark brow with two pale rings each on the second and third joints. Fore wing mixed brown ish and bluish black, with a large, irregular, bilobed, yellow or orange dorsal patc normally extending to costa at a third way out, and a white, postmedial costal spo A jet black spot in cell. 12 mm. (*costipunctella* Möschler; *Parastega* Mayrick)

August and September. Caterpillar on *Cassia chamæcrista*, green, with hea cervical shield, feet, and the small tubercles black; thorax mostly deep purplis red.

District of Columbia to Chicago, Illinois; Kansas; and south.

G. ochreosuffusella Chambers may approach our territory on the southwest. I is dark brown; third segment of palpus light, with two narrow brown ring thorax, base of fore wings, and a streak in fold yellowish. Fore wings finel veined with dark brown, with four fine dark lines in the cell. 18 mm. July t September.

11. **G. fluvialella** Busck. Brown, somewhat yellowish, the veins broadly an diffusely lined with dull black; often with the blackish color suffusing considerabl areas of the wing. Discocellular vein marked with a blackish spot. Hind win somewhat paler gray; rather broader than fore wing; palpi with second join somewhat dusted with white, no darker than third, but darker than fore wing brush as wide as eye, widest about the middle. Wings relatively broad, with broa fringes. 18–22 mm.

June to early July.

Pennsylvania. New York: Peru, Rock City, Ithaca.

12. **G. hibiscella** Busck. Dark Brown, antennæ concolorous; palpi with larg spreading brushes on second segment, yellowish white with a few black scale outside, extreme tip of second segment and an annulation of third black. Face head, and thorax yellowish white; shoulders and sometimes entire tegulæ blackish Fore wing with brown or brown-black costal half, and ochreous dorsal half an apex; the boundary slightly diffuse. Dark part showing obscure pale spots an pale part with dark bars and striæ. Hind wing a little broader, light bluish fuscous with yellower fringe. 16 mm.

May to June; August. Caterpillars on leaves and capsules of rose mallo (Hibiscus), semisocial, when mature often cutting a leaf to make it wither, an form a shelter for pupation. Head and cervical shield black; thorax reddish brown with third segment and front of second white; abdomen white with thre pairs of reddish dorsal lines. Tubercles black. Two broods; the larva hibernating

New Jersey to Illinois.

G. ochreostrigella Chambers is a western species, or western race of *G. hibiscella* which has been reported from the northeast.

13. **G. discoccellella** Chambers. Dark purplish brown, as a rule, shading int wood-brown toward inner margin. Veins sometimes darker. Outer discal do yellow, usually with a black point in the center, at least in the female. Hin wing pale and yellowish, palpus light dull yellow, with second and base of thir segment nearly black. 18 mm.

Caterpillar on yellow dock (Rumex), and Polygonum; green, with yellow-gree

ead and cervical shield; in a slight web on under side of a leaf; skeletonizing he leaf. Moth flying in late June and July and again in September.

Northern New Jersey and District of Columbia to Kansas and Texas.

A. anarsiella Chambers, an immaculate, powdery, steel gray species without any lefinite markings, probably occurs in the northeast; its larva feeds on Ceanothus.

14. **G. albisparsella** Chambers. Brush on palpus long, ragged, but not distinctly livided. Moth dark gray-brown, the head a little paler and somewhat iridescent. 'alpi and antennæ dark brown. Fore wing with small pale spots at middle and nd of cell, and an indistinct, sometimes broken, whitish fascia beyond. 15 mm. *platanella* Chambers).

Caterpillar on Platanus, in a roll made of the down on the under side of the leaf.

Western Pennsylvania; Kentucky. New York: Ithaca.

G. fluvialella has been determined as the same as this species but it appears quite listinct.

15. **G. inquilinella** Busck. Palpus with second segment white, dusted with black; hird, blackish fuscous, somewhat dusted with white. Antennæ blue-black, with white dots on segments below. Head dark gray, with black-tipped vestiture. Face ight steel gray; thorax blackish fuscous. Fore wing whitish, heavily dusted and uffused with blackish fuscous, appearing dark gray. Discal dots obscure, normal, lack. Fringe light gray. Hind wing wider than fore wing, light shining fuscous vith paler and yellower fringe; with **R** and M_1 short-stalked and M_3 and Cu_1 onnate. 14–15 mm.

Larva inquiline in *brassicoides* gall on Salix; moth in the spring.

Karner, New York.

16. **G. unctulella** Zeller. Evenly fuscous, including thorax. Orbicular and reniorm blackish, not prominent; the other dots very faint; a row of black basal cales in fringe. Head concolorous. Second segment of palpus deep black, without a strong tuft. 15–18 mm.

Caterpillar webbing leaves of locust (Robinia), sometimes in injurious numbers. Gray; dorsum finely striped with dull red; head and cervical dull yellow; ocoon between two or three leaves; pupa chestnut brown, very broad and flat.

North Carolina; Colorado; Texas; Arizona; and probably more generally listributed.

17. **G. lynceella** Zeller. White, dusted with blackish; with parallel oblique blacksh shades; **1**, along base of inner margin, **2**, usually obscure, from near base of osta to inner margin, closely parallel to **1**; **3**, across middle of wing, strong; , more or less obscure, half way across wing two-thirds way out, then zigzag to nner margin. A chevron of black dusting over apex. Fringe pale, slightly dark usted; head, thorax, and palpi powdery, nearly concolorous. 15 mm.

May.

Texas; Cincinnati, Ohio.

18 **G. bicostomaculella** Chambers. Ground dark gray with a purple luster, formed f heavy black dusting on a pale blue-gray ground. Palpus with second and third egments dark, powdery, and with a few pale scales, leaving two darker bands on econd segment. Head, whitish; a few dark scales on face and many on vertex; ntennæ dark. Thorax gray, evenly powdery, with only the usual basal hair on netathorax yellow. Fore wing with small, fugitive, white tufts, with some yellow cales, especially near the tufts. Most distinct marks of fore wing black spots ear middle and at end of cell, a bar from the first to the costa, with a spot in he fold below it, and a pale postmedial fascia, all formed of the powdering and vanescent under a lens. Hind wing with **R** and M_1 stalked, M_3 hardly connate with Cu_1; male with a strong hair pencil near inner margin. 14 mm. (*Adrasteia uercifoliella* Chambers.)

Caterpillar pale yellowish; head and thorax dark brown, with shining cervical hield; in a web on either side of leaves of black oak; skeletonizing the leaf around ts web.

I have seen authentic material only from Missouri. It is doubtless genera "New York" (Beutenmüller).

19. **G. maculimarginella** Chambers. Closely similar to *G. bicostomaculelle.* Hea usually more dominantly white; scutellum with a contrasting yellowish whit tuft; fore wing more crisply powdered, usually with postmedial line represente by prominent white spots on costa and inner margin. The yellow on fore wing more distinct. 13 mm.

Caterpillar with head, feet, and cervical shield polished black; pro- an mesothorax paler, white in front; abdomen with four purple stripes posteriorly o segments, joining a purple transverse band in front. Two or more broods; on oak the first brood feeding in the buds, and emerging in May, the second between spu leaves in June, emerging in July.

Distribution general. New York: Buffalo (Wild), Ithaca.

20. **G. vernella** Murtfeldt. Violet-gray, more or less dusted with blackish; eac scale of ground violet with black tip. Palpus with second segment yellowish wit a strong yellow brush, and third blackish, contrasting. Thorax with small yello posterior tufts. Fore wing with a strong black antemedial patch over cell an fold, with yellow dots before and beyond it, connected by an oblique black bar t costa. Outer part of wing blackish, with contrasting but diffuse white postmedi costal and dorsal spots; extreme margin and fringe powdery gray like base. Fir dorsal dot black, more intense than the patch in which it lies. No tufts. Hin wing paler, with a weak pencil near inner margin. Easily distinguished from th other species of this group by the yellow palpus. R and M_1 of hind wing separat 15 mm. (*formosella* Murtfeldt, not Hübner).

Larva on laurel oak, in May, rolling the leaves. Head and cervical shiel black; body gray with six or eight purplish stripes; meso- and metathorax choc late, their anterior two-fifths white. Pupa in a folded leaf. Moth in July.

This species is perhaps nearest *G. gilvomaculella*, which has been confused wit it. It has been bred in New Jersey and Missouri and emerges in June.

New York: Ithaca.

21. **G. dyariella** Busck. Palpus jet black on outer side. Fore wing fuscou somewhat mottled; head and thorax concolorous. Fore wing marked with black a follows: a dot or small streak on base of R and of A, a noticeably irregular, blac bar running obliquely out from costa a fourth way out, to fold, connecting wit the orbicular and claviform dots, which form extensions of its distal side, a blac bar at end of cell, connected to a vertical bar resting on the anal angle, and blac dots in cell before this. A fuscous subterminal fascia. Hind wing paler towar base. 18 mm.

June; larva on poplar.

Western Pennsylvania to Colorado.

23.[19] **G. nigrimaculella** Busck (Chambers ms.). Fuscous, sprinkled with dar brown, black, and whitish; palpi with a well developed brush; head and thora largely brown, the face not pale. Fore wing with costal edge black, whitish below two short oblique dashes on disc; large black costal and dorsal spots at beginnin of fringe, with an obscure pale angulate fascia beyond. Abdomen white in middl below. 13 mm.

July to August. Closely similar to *G. vernella;* most easily distinguished b the dark face.

Southern Massachusetts to western Pennsylvania. New York: Ithaca.

24. **G. gilvomaculella** Clemens. Ground fuscous, somewhat bluish, and a littl powdery, but less than in *G. nigrimaculella.* Head concolorous; face pale below second segment of palpus with large brush, blackish, lightly dusted with pal yellow; third slender and mostly black. Fore wing somewhat shaded with ye lowish, especially on costa; the costa with broad obscure blackish bars, and a pal

[19] Number 22 is vacant.

treak from beginning of fringe nearly meeting one from inner margin. A large lackish spot in cell and a smaller one before it in fold, both more or less flanked ith yellow scales and minute tufts. Second discal dot much smaller, inconpicuous. Abdomen mottled below. 18 mm. (*biminimaculella* Chambers).

Caterpillar on oak. Moth in July.

Pennsylvania (?); Missouri; Texas. New York: East Aurora, Ithaca.

25. **G. pseudoacaciella** Chambers. Dark purplish brown, somewhat powdery, ecked and streaked with ochreous and white; head, antennæ and palpi mixed rownish and white. Fore wing with a pale subcostal streak from base to apex, ometimes obscure, a pale spot at beginning of costal fringe and a dorsal one pposite, sometimes joined into an obscure fascia. First three segments of abdomen orsally with finely toothed contrasting yellow scales. 18 mm. (*cæcella* Zeller).

The markings are strongly variable but the species may be distinguished from ost Gelechiidæ by the yellow base of the abdomen (which occurs more often in norimoschema than Gelechia). Often the costal region is shaded or suffused with rown, and the antemedial oblique bars may be absent.

Caterpillar on Robinia, often invading mines of other Tineids, especially when oung; later between leaflets sewed together. Green with light brown head and ervical shield; abdomen with subdorsal and stigmatal stripes and addorsal and ateral spots; larva, when young, black. Moth in May and June, and August.

Western Pennsylvania; southern Ohio; Illinois.

26. **G. serotinella** Busck. Very similar to *G. pseudoacaciella* and not always listinguishable in the imago, but usually with the costa practically concolorous, or rown; never whitish; less streaked looking. 16–21 mm.

Larva on *Prunus serotina*, in a nest formed of a folded leaf, the caterpillar eeding in a chamber roofed with a heavy sheet of white silk, and living in a black rass tube, much like Catastega. Cocoon within the frass tube. Caterpillar whitish, vith brown head and cervical shield, with brown narrow addorsal lines on body, nd four broader lines on sides; when young greenish white with black head and ervical shield.

Moth in July and August.

District of Columbia; Virginia; Illinois; Missouri; Colorado.

27. **G. fondella** Busck. Powdery light fuscous. Antennæ annulate black and chreous; palpus sprinkled with black; head and thorax concolorous; fore wing vith each scale darkening to tip, faintly roseate; two conspicuous black spots risecting the costa, and converging below, the outer strongly oblique, and covering rbicular as well as reniform. Extreme apex dusted with black, not contrasting. Hind wing light ochreous fuscous. Legs pale, with black bars on outer side. Sometimes with the orbicular and reniform separate from the postmedial bar, but he orbicular always very large and touching the reniform. 13–14 mm.

June.

Maryland to western Pennsylvania.

28. **G. pseudofondella** Busck. Dull ochreous, slightly dusted with black. Palpi vith slight black mottling and bar near tip; head pale; fore wing with black dots n edges at extreme base and dot in fold near base; an outwardly oblique antenedial fascia from costa to fold; a more diffuse postmedial fascia reaching inner nargin and covering the reniform; and a small blackish orbicular spot between hem. Apex heavily shaded with blackish. 14 mm.

June to July.

Northern New Jersey to North Carolina and Illinois. New York: Ithaca.

29. **G. mediofuscella** Clemens. Clay color, dusted in varying proportion with lull black; antennæ annulate with white and blackish; palpi dominantly dark. Fore wing with base dominantly of the ground color, ending at a black oblique ascia from costa to fold, defined on inner side. Outer part mottled and dusted vith black, gradually shading into the black fascia; usually without definite narkings.

This species is rather similar to some forms of the *bicostomaculella* group, but with no blue tint, and with the hair pencil very weak. In dark specimens the yellow base may be almost obliterated; in light ones it is continued by a band along the inner margin to beyond its middle. This is one of our species which come closest to the subgenus Lita, but its hind wings are too broad to be typical. 10–15 mm. (*vagella* Walker, *fuscoochrella* Chambers, *Lita liturosella* Zeller).

Early spring; July. Larva in seeds of *Ambrosia trifida.*

General in distribution and not rare. New York: Peru, Rock City, (Cattaraugus County), Crosby, Potter Swamp (Yates County).

30. **G. walsinghami** Dietz. Palpi ash gray; outer side of first and base of second joints fuscous; tuft divided, dusted with fuscous; third joint dusted with fuscous, with a broad dark ring. Antennæ faintly annulate. Head, body, and fore wings gray; a dark brown posterior spot on thorax. Fore wing marked with dark rich brown; a triangular sub-basal patch, not reaching costa; a longitudinal stripe through middle of apex, defined below and interrupted by a pale postmedial fascia which is defined inwardly and preceded with brown at costa. Some raised white scales in fold. 15 mm. (*Pseudochelaria* Dietz).

Late May to July. Caterpillar pale green, in a white web on under side of leaves and along petioles of *Rhus typhina* in late August and September.

Western Pennsylvania; Anglesea, New Jersey. New York: Ithaca.

31. **G. pennsylvanica** Dietz. Similar to *G. walsinghami.* Dark basal area extended outward toward end of cell, where it joins the longitudinal streak, and reaching base of inner margin; the transverse fascia less conspicuous. 15 mm.

July.

Western Pennsylvania.

32. **G. tephriasella** Chambers. Pale gray, dusted with white; palpi dark brown, second joint white-tipped, third white-dusted, with a white annulus; antennæ light gray and white, *with three or four strong annuli toward tip* (like *Aristotelia absconditella* and *Duvita conclusella*). Fore wing with each gray scale white-tipped; wing darker toward apex; a narrow, white fascia at beginning of fringe, an oblique streak from costa before middle, and obscure darker terminal dots. 10 mm.

Kentucky. Type lot only known.

33. **G. nundinella** Zeller. Pale buff or cream, with yellow-brown shading and sparse black dusting, tending to form longitudinal striation toward border and oblique shading on disc. Palpus pale with two brown patches each on second and third segments. Hind wing somewhat grayer. 20 mm. (*beneficentella* Murtfeldt).

Caterpillar on *Solanum carolinense,* the first brood webbing the terminal leaves into a hollow ball, the second brood in the berries. Pupa in the nest. Larva with head and cervical shield black when young, olive-brown when mature. Body yellowish green with dark glaucous dorsal stripe.

District of Columbia; Texas; Missouri.

As the moth has R and M_1 quite widely separate at origin, though divergent, and the third segment of the palpus is rough, it would probably be better considered a Gnorimoschema or primitive Phthorimoea without pencil, but is usually placed here. The pupa also is unlike other true Gelechias, though far from the other Gnorimoschemas and Phthorimœas studied.

34. **G. arenella** Forbes. Pale clay-color, the veins perceptibly paler, with some scattered black scales; black discal dots and a dot in the fold; black terminal dots. 20 mm.

May, June, and August.

Massachusetts, on the coast. New York: Rockaway Beach.

The species is not close to *Gelechia petasitis,* of Europe, with which it has been confused.

35. **G. branella** Busck. Dull dirty ochreous, a little uneven; face paler; antennæ paler, annulate with black; palpi fuscous, the inner side and apex of second seg-

nent pale. Fore wing with extreme base of costa black, and some scales on inner margin; a black dot near base; two discal dots, and a contrasting dot in fold before the first one. A series of diffuse black terminal dots. 13 mm. This moth is superficially much like *Aristotelia quinquepunctella* and some Tineas.

G. (Teleia) **sequax** of Europe was reported by Zeller from Massachusetts. It may be distinguished by the hind wing narrower than the fore wing and narrower than its own fringe, and by the black dash in the apex.

The following nominal species are unknown to me. Many of them have not been recognized since their description, and a fair proportion are likely not to be true Gelechias.

G. ambrosiæella Chambers. Cincinnati Quart. Journ. Sci., vol. 2, p. 239. 1875. Kentucky.
G. angustipennella Clemens. Proc. Ent. Soc., Philadelphia, vol. 2, p. 119. 1864. Pennsylvania?
G. aurimaculella Chambers. Canad. Ent., vol. 4, p. 172. 1872. Kentucky.
G. badiomaculella Chambers. Canad. Ent., vol. 4, p. 192. 1872. Kentucky.
G. brackenridgella Busck (*detersella* Clemens, not Zeller). Proc. Acad. Nat. Sci., Philadelphia, 1860, p. 164. Pennsylvania.
G. brumella Clemens. Proc. Ent. Soc., Philadelphia, vol. 2, p. 416. 1864. Labrador.
G. capiteochrella Chambers. Cincinnati Quart. Journ. Sci., vol. 2, p. 252. 1875.
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G. caryævorella Packard. Rept. U. S. Dept. Agr., 1885, p. 331. 1885. Rhode Island.
G. cassella Walker. List Lepid. Ins. Brit. Mus., part 29, p. 594. 1864. North America.
G. discoanulella Chambers. Cincinnati Quart. Journ. Sci., vol. 2, p. 254. 1875.
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G. flavicorporella Walsingham. Trans. Amer. Ent. Soc., vol. 10, p. 177. 1882–3. Massachusetts.
G. flexurella Clemens. Proc. Acad. Nat. Sci., Philadelphia, 1860, p. 163. Pennsylvania.
G. fuscoluteella Chambers. Canad. Ent., vol. 4, p. 106, 147. 1872. Kentucky.
G. fuscomaculella Chambers. Canad. Ent., vol. 4, p. 170. 1872. Kentucky.
G. fuscopunctella Clemens. Proc. Ent. Soc., Philadelphia, vol. 2, p. 12, 121. 1864. Pennsylvania?
G. griseaella Chambers. Canad. Ent., vol. 4, p. 88. Canada. (*grisseella* Chamb. Bul. U. S. Geol. and Geog. Surv. Terr., vol. 4, p. 144. 1878.)
G. grisella Chambers. Canad. Ent., vol. 4, p. 171. 1872. Kentucky.
G. immaculella Kearfott. (Not published?)
G. labradorica Mœschler. Canad. Ent., vol. 4, p. 125. 1872. Labrador.
G. liturella Walker. List Lepid. Ins. Brit. Mus., part 29, p. 591. 1864. Nova Scotia.
G. milleriella Chambers. Cincinnati Quart. Journ. Sci., vol. 2, p. 253. 1875.
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G. mimella Clemens. Proc. Acad. Nat. Sci., Philadelphia, 1860. p. 163. Pennsylvania?
G. obscurella Chambers. Canad. Ent., vol. 4, p. 170. 1872. Kentucky.
G. obscurusella Chambers. Canad. Ent., vol. 4, p. 106, 128, 148. 1872. Kentucky.
G. ornatifimbriella Clemens. Proc. Ent. Soc., Philadelphia, vol. 2, p. 420. 1864. Illinois.
G. palpialbella Chambers. Cincinnati Quart. Journ. Sci., vol. 2, p. 253. 1875.
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G. pullifimbriella Clemens. Proc. Ent. Soc., Philadelphia, vol. 2, p. 120. 1864. Pennsylvania?
G. punctiferella Clemens. Proc. Ent. Soc., Philadelphia, vol. 2, p. 119. 1864. Pennsylvania?
G. rileyella Chambers. Canad. Ent., vol. 4, p. 106, 147. 1872. Kentucky.
G. simpliciella Chambers. Cincinnati Quart. Journ. Sci., vol. 2, p. 238. 1875. Kentucky.
G. suffusella Chambers. Canad. Ent., vol. 4, p. 171. 1872. Kentucky.
G. thoraceochrella Chambers. Canad. Ent., vol. 4, p. 169. 1872. Kentucky.
G. unistrigella Chambers. Canad. Ent., vol. 5, p. 176. 1873. Kentucky.
G. versicolorella Chambers. Canad. Ent., vol. 4, p. 127, 147. 1872. Kentucky.

3. *GNORIMOSCHEMA* Busck

(*Lita; Gelechia,* in part)

Closely similar to Gelechia. Third joint of palpus thickened with rough scales except at extreme tip; second joint with distinct divided brush, variable in size. Fore wing as in Gelechia, a considerable proportion of the scales usually finely tipped with white. Hind wing (figs. 159, 160) with acute subfalcate apex, long-drawn-out in the smaller species. R and M_1 well separated at base, more than half as far apart as at margin, but divergent. No hair pencil.

This is a medium-sized genus, composed of two well-distinguished groups. In the large typical forms the hind wing is only subfalcate and is broader than its fringe; their larvæ are gall-makers in various Compositæ, cutting an exit hole just before pupation and pupating in the gall. The smaller group have narrow, long-drawn-out hind wings, with a fringe broader than the membrane. The biology of this group is none too well known, but a couple of species, at least, feed on Solanaceæ like the Phthorimœas. Only members of the second group are known in Europe, where they are not generally separated from Lita. The species run very close, and the key will not be wholly trustworthy.

Key to the species

1. Scales practically all dark-tipped.
   2. Fore wing almost evenly black, with a few scattered, white-tipped scales and a considerable showing of white scale-bases.....8. *busckiella.*
   2. Fore wing powdery fuscous gray, without black.....1. *detersella.*
1. A considerable proportion of scales with fine white tips (most prevalent in the moderately light, grayer parts of the fore wing; practically confined to the postmedial line and fringe in *G. banksiella*).
   2. Fore wing with inner fourth distinctly paler than costal fourth.
      3. Head and palpi whitish (except outer half of third segment of palpus).
         4. Fore wing deep, rich, rusty brown.....2. *gallædiplopappi.*
         4. Fore wing light ochreous.....3. *pallidochrella.*
         4. Fore wing largely whitish, with a dark streak on fold..4. *gallæasteriella.*
      3. Head and palpi rather dark powdery gray, about like the gray parts of the wings.....5. *gallæsolidaginis.* 6. *salinaris.*
   2. Costal and dorsal parts concolorous; mostly smaller species.
      3. Fore wing heavily streaked with clay-color, leaving a broad, longitudinal dark streak from base to apex.....11. *henshawiella.*
      3. No dark longitudinal streak.
         4. Fore wing with three ocellate, brown, dark-centered discal spots. 10. *triocellella.*
         4. With obscure ocellate spots or none.

5. A heavy, blackish, oblique bar from costa near base, crossed by a more or less distinct dark streak running from middle of costa toward base of fold.....12. *lavernella.*
5. No heavy, black, oblique bar in antemedial region.
6. Expanse about 18–25 mm. Obscurely streaked longitudinally with gray and blackish.....18. *alaricella.*
6. Expanse about 12 mm., or ground brown and not streaked.
7. With yellow longitudinal streaks between veins.....13. *axenopis.*
7. Yellow longitudinal streaks absent or rudimentary (about as wide as a scale).
8. Ground white, lightly dusted with black-barred scales; antennæ with white annulations broader than dark ones.
9. Slightly yellowish, with very irregular powdering. 14. *batanella*
9. No yellow shade; with even powdering; larger than *G. batanella*.....15. *petrellæ.*
8. Fore wing not mostly white; white annulations on antennæ narrow.
9. Fore wing, thorax, head, and palpi suffused with pink. 9. *brackenridgella.*
9. Not suffused with pink.
10. Black-dusted on white; each scale with a heavy black bar and only a few showing the white tip.....8. *busckiella.*
10. A large, irregular, evenly colored, chestnut-brown area, contrasting with the black ground.....17. *banksiella.*
10. Broadly shaded with brown and powdery blackish; with no contrasts at all and no sharp boundaries. 7. *subterranea.*
10. Nearly unicolorous fuscous (not seen). 16. *scutellariœella.*
10. Evenly powdered dull fuscous with four black dots on disc.....*chenopodiella.*

1. **G. detersella** Clemens. Head grayish fuscous; palpi pale yellowish white, with two fuscous patches on second segment; a very narrow ring near base and a broad one near tip of third segment. Antennæ annulate, lighter and darker fuscous, without any white. Fore wing grayish, each scale outwardly fuscous, without any white tips; obscure darker dots at middle and end of cell and one in fold. Fringes and hind wing pale ochreous gray; fringes of hind wing yellower. 11 mm. (Not seen).

Pennsylvania.

2. **G. gallædiplopappi** Fyles. Deep Indian red, including thorax; unspotted, but with a divided pale fascia near hind margin. Head white; upper part of palpus brown, with a white ring on tip of second segment. 22 mm.

The caterpillar forms a gall well up in the main stem of *Diplopappus umbellatus.* The pupa is suspended in the gall, but the exit hole is not plugged nor the gall lined with silk. (This may be merely a stained specimen of *G. gallœasteriella.*)

Canada.

3. **G. pallidochrella** Chambers. Pale ochreous all over; palpus with two dark rings on third segment; antennæ annulate at tip only, brown; fore wing sparsely dusted with fuscous, and with an oblique line across base of wing; a second line a fourth way out; apex fuscous. Hind wing duller. 19 mm. (Not seen.)

Kentucky.

4. **G. gallæasteriella** Kellicott. White, spotted with brown and blackish, and lightly dusted with black; with only the middle of the costal half dominantly dark, as a rule; a large central costa patch running down to a small bar in fold.

Palpi white, second segment with a little gray, third with outer half except extreme tip black. 22 mm. (*asterella*, in error).

Caterpillar in a more or less triangular gall on top of dwarfed stems of *Solidago latifolia*, *cæsia*, *axillaris*, and *Aster divaricatus*, the forms of the gall differing with the plant. Hole cut and plugged before pupation.

Canada to Pennsylvania and Michigan. New York: Ithaca.

5. **G. gallæsolidaginis** Riley. Powdery gray, including head and palpus; most of the scales pale at base with a heavy black bar and fine white tip. Basal half of third segment of palpus contrastingly pale; fore wing with middle half of wing toward costa heavily shaded with brown or brownish black, contrasting, and with the boundary toward base oblique and fairly definite. Some dark shading also near base of inner margin and toward apex. 22 mm.

Caterpillar in stems of goldenrod, not stopping the growth of the plant, but often slightly dwarfing it; forming a fusiform gall. Pupa in a silk hammock suspended opposite the emergence-hole, which is plugged. Parasitized caterpillars (*Copidosoma gelechiæ*) grow abnormally large and die before cutting the exit-hole. The moth emerges in late August, and is said to hibernate occasionally. The eggs are normally laid in the fall, and hibernate.

General in distribution and not rare. New York: Vicinity of Buffalo, Ithaca, Big Indian Valley, Albany; Richmond Hill, Long Island.

6. **G. salinaris** Busck. Closely similar to *G. gallæsolidaginis* but averaging slightly smaller and broader winged; band on third segment of palpus less definite; fore wing with markings slightly more diffuse and tending a little to longitudinal striation. 20–22 mm.

The moth flies early in September. The larva hatches the same year, but does not begin to form the gall till the following spring. The gall is similar to that of *G. gallæsolidaginis*, but usually nearer the ground; in *Solidago salinaris*.

Coast of Massachusetts.

7. **G. subterranea** Busck. Body blackish, dusted with white. Antennæ with black, brown, and white; fore wing rich reddish to chocolate brown, irregularly sprinkled with blackish, white-tipped scales; fringe whitish, brown-powdered. Hind wings yellowish fuscous with grayer fringe. Abdomen as usual, with yellow at base. 18 mm.

Early September. Galls small, about 15 mm. long, at the bases of the clustered stems of *Aster multiflorus*; usually in a cluster.

Boston, Massachusetts.

8. **G. busckiella** Kearfott. Dull black, dotted all over evenly with the white scale-bases; a few of the scales also narrowly white-tipped. Head, thorax, and palpi also mainly black. Hind wing blackish fuscous. 18 mm.

The caterpillar forms a long, cylindrical gall in the side-branches of *Aster patens* dwarfed by *Thiodia radiatana*, and stops the growth of these side-branches beyond the galls. The larva may be found in July and August, the moth in November.

Northern New Jersey.

9. **G. brackenridgella** Busck. Moth similar to *G. subterranea* but with the whole wing, including the fringe, brownish, and strongly suffused with pink, and also the head, palpi, and thorax. No definite markings but traces of a longitudinal shade rather below middle of wing outwardly. 20 mm.

Gall quite like *G. gallæsolidaginis*, but smaller; in stem of aster. Moth in October. This may be the same as *G. septentrionella* Fyles.

Magnolia, Massachusetts.

10. **G. triocellella** Chambers. White, contrastingly shaded and dusted with black; whitish ante- and postmedial white fasciæ, converging toward inner margin, a little diffuse, and defined with black shades. Large black antemedial and discal dots, and a similar dot in fold, ringed with white and buff, and with some buff shading near base. 12 mm.

Colorado; reported by Dietz from New Jersey.

11. **G. henshawiella** Busck. Whitish, with scattered fuscous-barred scales which gather into a contrasting dark band from base to apex, a third as wide as the wing or more, leaving the costal side of the streak much wider, and suffused and streaked with brown. A couple of black dashes on the upper edge of this band and one in the fold on its lower edge. Irregular, black terminal dots. Head and thorax pale; palpi with four more or less distinct dark bands. 12 mm.

Eastern specimens are not typical and may represent a new species. Barnes and McDunnough consider this a synonym of *G. ochreostrigella*.

May and June.

Hampton, New Hampshire; western Pennsylvania; also South Dakota and west.

12. **G. lavernella** Chambers. Fore wing black-powdered on pure white, shaded and noticeably streaked with yellow-brown; palpus yellowish with two dark rings on third segment. Fore wing mottled with black; a heavy fascia from costa near base obliquely out to fold, where it may enlarge into a patch, and is met by a more or less distinct dark streak from costa near middle to base of fold. The latter often broken, or partly obsolete. Postmedial fascia distinct, defined with dark. 12 mm. (*physalivorella* Chambers).

Larva in fruit of Physalis.

District of Columbia; Ohio; Michigan; and west.

13. **G. axenopis** Meyrick. Palpus with second segment powdery gray, third white with two slender, blackish bands. Shoulders tinted with yellow; fore wing powdery gray, with several rusty yellow streaks between the veins, toward apex breaking up into a series of oblique streaks between the veins. 11 mm. (*artemisiella* Kearfott, not Treitschke).

Meyrick considers this a Phthorimœa. It will almost certainly be congeneric with *"Lita" artemisiella* of Europe.

Caterpillar webbing together the young terminal leaves of *Artemisia canadensis*, and eating back into the stem.

Atlantic States.

G. saphirinella Chambers is similar, but with nearly white second segment of palpus, blackish shoulders, and more brilliant orange-red stripes on wing. Eastern records should probably be credited to *G. axenopis*.

14. **G. batanella** Busck. Antennæ annulate with black and white, the white annulations as wide as the black; and without distinct brown ones. Palpi obscurely annulate. Fore wing white, usually lightly dusted with black; the black gathering into a shade at apical third, or defining an angulate pale postmedial line; four small yellow and light brown spots at middle and end of cell, and middle of inner edge, and two more farther out, all obscure and variable; fringe white, black dotted, and with a broken black line. 12 mm.

June.

New Jersey to western Pennsylvania.

15. **G. petrella** Busck. Head, palpi, thorax, and wings white; almost evenly and moderately dusted with fuscous, the white dominant. Antennæ white, ringed with black. Discal dots blackish, not contrasting. 17 mm.

May.

Hampton, New Hampshire.

16. **G. scutellariæella** Chambers. Fore wing dark powdery fuscous, each scale bluish at base and finely tipped with white; apex paler, with ill-defined whitish costal and dorsal streaks; palpi yellowish within. 9 mm.

The caterpillar is white, with a pale yellow head; and lives in a flat, curved case covered with frass, which it leaves to mine in a leaf of the food plant. Apparently, a single case is used, which is permanently attached by the smaller end. Food: Scutellaria.

Only the type is known.

Kentucky.

17. **G. banksiella** Busck. Blackish. Palpus light gray on dorsum of second segment and extreme apex of third; antennæ narrowly ringed with white. Fore wing with white powdering at apex, and indicating a broken postmedial fascia; disc of wing occupied with several rounded, even, chocolate or yellow-brown spots, which are often confluent into an irregular patch; and a more diffuse band on fold and inner margin. First two segments of abdomen yellow on dorsum (as usual in the genus). 12 mm.

Moth in July and August. Caterpillar on Solidago.

Massachusetts to western Pennsylvania. New York: Essex County, Batavia, East Aurora, Otto, Ithaca, Sea Cliff.

18. **G. alaricella** Busck. Powdery fuscous gray, the dominant scales with dull luteous base and white tip; intermixed with yellow scales, which tend to gather in numerous obscure longitudinal streaks. Discal dots black, rather elongate, obscurely ocellate with the yellow. Costal edge blackish, contrasting. Palpi powdery gray with a narrow basal and a broader outer ring on third segment. Antennæ annulate. 18–25 mm.

Western Pennsylvania.

4. *PHTHORIMŒA* Meyrick

(*Bryotropha; Lita; Gelechia,* in part)

This genus is closely similar to Gnorimoschema. The white-tipped scales are perhaps less frequent. The third segment of the palpus averages more smoothly scaled. The male has a heavy pencil of hair at the base of the hind wing above, distorting the venation. The known caterpillars all feed on Solanaceæ and appear to be rather similar in habits. The names "potato tuber moth" and "tobacco splitworm" apply especially to *P. operculella*, but some of the accounts of injury seem to be based on other species. The species are close and difficult to recognize, *P. operculella* and *glochinella* being often indistinguishable in the female.

Key to the species

1. Fore wing with a couple of longitudinal black stripes.....2. *striatella.*
1. Fore wing not black-striped.
  2. Strongly mottled with dark brown, with a series of dark spots along costa outwardly .....4. *marmorella.*
  2. With only the ordinary dots and a faint series of terminal dots dark.
    3. Expanse 7 mm.....(1) *minor.*
    3. Expanse over 10mm.[20]
      4. Normally larger, yellow scaling more distinct and forming well marked longitudinal streaks; male with large dorsal and ventral flat lobes to genitalia, covering the valves.....1. *operculella.*
      4. Normally smaller; yellow scaling obscure and usually not gathering into longitudinal lines, sometimes practically absent; male with dorsal and ventral lobes small and tapering; valves slender, claw-like, exposed .....3. *glochinella.*

1. **P. operculella** Zeller. Powdery gray, streaked between the veins with pale ochreous. Head pale, usually cream white; palpi similar, with a few gray scales. Antennæ grayish, annulate with dull black. 12–16 mm. (*Bryotropha solanella* Boisduval).

This species breeds continuously in the warmer season in stored potatoes, having many broods a year. The caterpillar is whitish, often with some pink or green shade, with a black head and cervical shield. Typically, when young it is a leaf-

[20] See also *Gnorimoschema axenopis.*

miner; later it enters the large veins of tobacco, or the shoots of potato. Eggs are also sometimes laid on the surface of potatoes if left exposed above ground in the field or in storage. In that case the young larvæ feed at first just under the skin, and later bore through the potato in all directions. Pupation takes place in a cocoon outside the burrow, as a rule. The larva also works in leaves, stems, and fruits of other Solanaceæ.

The distribution is general southward.

P. minor Busck is an exactly similar, but much smaller, form, or species, from the far South.

2. **P. striatella** Murtfeldt. Antenna blackish. Fore wing light wood-brown, streaked with dark brown and with some powdery gray, especially at apex and in fringe. A black streak from base through upper part of cell to apex, and a broader irregular and diffuse one running above inner margin to anal angle. Genitalia much as in the following species. 12 mm.

Larva in berries of *Solanum nigrum;* pale greenish yellow with five irregular and interrupted crimson stripes, the lateral ones formed of series of spots; head, cervical shield, and true legs proportionately small, shining dark brown.

St. Louis, Missouri; California.

3. **P. glochinella** Zeller. Closely similar to *P. operculella.* Fore wing pale yellowish gray to the naked eye; under the lens the color made up of a mixture of black-and-white scales and pale ochreous scales, the latter often very few and usually scattered. Head usually powdery light gray, including palpi. Male genitalia with a short, triangular, dorsal plate, a slightly larger, trough-shaped, ventral one, and two slender, curved valves. Usually distinguishable from *operculella* by the evener coloration, but occasionally indistinguishable in the female. 12–14 mm. (*solaniella* Chambers, in part; *similiella* Chambers, in part, not *Ptycerata similiella*).

Larva green, becoming almost blue when mature; in a dense, silken, frass-covered tube, in a mine in leaves of *Solanum carolinense.* Pupa in a cocoon at surface of ground.

Missouri; Texas.

4. **P. marmorella** Chambers. Light yellowish fuscous, irregularly spotted and mottled with dark brown. 9 mm.

Types only known.

Kentucky.

5. *ANACAMPSIS* Curtis

(*Tachyptilia* Heinemann; with *Compsolechia* Meyrick)

Palpi with second segment smooth or slightly roughened above the middle; third longer, slender, and pointed; fore wings long with blunt apex, rounded outer margin, and well-marked anal angle above Cu_2. Venation as in Gelechia. Hind wing much broader (often nearly twice as broad as fore wing), rounded-trapezoidal, not sinuate, with normal venation; R and M_1 approximate; a fringe on Cu.

The moths of *A. agrimoniella* and *A. levipedella,* at least, walk in a circle on alighting, like the Choreutidae.

Key to the species

1. Fore wings without any markings on basal half; though usually with light outer markings.
2. With a white transverse fascia.
3. Two or three longitudinal white apical dashes, sometimes fusing into a white terminal bar.....8. *tristrigella.*
3. Without white terminal dashes.
4. Markedly darker beyond fascia.....7. *agrimoniella.*
4. Ground equally dark both sides of the fascia.....6. *lupinella* in part.

2. No transverse fascia.
3. One white costal streak or none.
4. Palpi yellow ..... 5. *nonstrigella*.
4. Palpi dark brown ..... 6. *lupinella* in part.
3. Two white costal spots ..... 9. *levipedella*.
1. Basal half of fore wing more or less mottled.
2. Crisply dusted and marked with black on white ..... 2. *niveopulvella*.
2. Ground practically even.
3. Postmedial line indicated by a white dot at costa and a yellow one on inner margin; palpi unicolorous whitish, more or less contrasting 4. *crescentifasciella*.
3. Postmedial line all one color and continuous or nearly so, often faint.
4. Ground ash gray. Larger. Second segment of palpus blackish with whitish tip ..... 1. *innocuella*.
4. Ground gray-brown. Smaller. Second segment of palpus unicolorous, about the color of the fore wing ..... 3. *rhoifructella*.

I. *Second segment of palpus with a loose tuft above* (Anacampsis).

1. **A. innocuella** Zeller. Ash gray, postmedial line paler, transverse, well out, waved, and followed by a blackish shade; three blackish dots in cell and one or two in fold. Palpus somewhat paler, with basal two-thirds of second segment blackish, contrasting. A slight tuft on upper side of second segment. 20–24 mm.

Common in July. The caterpillar forms a cylindrical roll of a leaf of poplar. It usually cuts the petiole early in the last stage, and finishes its feeding in the decaying leaf lying on the ground It may be found in June. It is transparent, the white fat and green food showing through; head black or black-brown, cervical shield brown, with black sides and posterior edge, true legs and tubercles black.

Massachusetts to Colorado. New York: Ithaca, Ilion, Pearl River. Cold Spring Harbor, Long Island.

2. **A. niveopulvella** Chambers. Palpi blackish, white at tip of second and upper side of base of third segments. Fore wing brownish black, heavily dusted with white, the markings as in *A. innocuella* but strongly contrasting, formed of the white powdering. 20 mm. Caterpillar on willow. Moth in July and August. Probably a contrasty variety of *innocuella*.

Quebec to Wisconsin and British Columbia.

II. *Second segment of palpus smooth above* (Compsolechia).

3. **A. rhoifructella** Clemens. Grayish fuscous, marked as in *A. innocuella*, the dark discal spots variable in size and often a much warmer yellow-brown. Palpi warmer yellow-brown, paler toward tip, but without any sharp contrast. 15–18 mm. (*consonella* Zeller, *ochreocostella* Chambers, *quadrimaculella* Chambers 1874, not 1875).

General from May to August. Caterpillar in the spring in the fruit-spikes of sumach (*Rhus typhina*), feeding on the crimson hairs and exterior coat of the drupes, living in a silken gallery within the cluster, and leaving strings of frass outside. Cocoon in a slight silken web near the surface, in the frass. Caterpillar immaculate, of various shades of brown with darker head and tubercles, and blackish cervical shield. There is a species apparently the same as this on Viburnum.

New York: West Farms (the Viburnum species).

4. **A. crescentifasciella** Chambers. Ash gray, finely dusted with brown; a very indistinct, pale, crescentic fascia at beginning of fringe, strongly concave toward base, and rarely absent. One or two minute dark spots in disc and one at apex. 12 mm.

April and May. Caterpillar on Krameria. This species has been confused with *Duvita conclusella.*

Kentucky; Texas.

5. **A. nonstrigella** Busck. Antennæ black, annulate with silvery white; palpi bright deep ochre, the joints black-shaded at tip; eyes dark red; face white, iridescent, shading into the dark olive brown, iridescent vertex and thorax. Basal two-thirds of fore wing dark olive, apex blackish with a few golden brown scales. Hind wing dark purplish fuscous; fringe of inner margin white. Abdomen yellow below, black and white annulate above. 15 mm.

July and August.

Northern New Jersey; western Pennsylvania.

6. **A. lupinella** Busck. Brown-black with a straight, dull white postmedial fascia, sometimes interrupted or nearly obsolete. Wing sometimes streaked with brown; palpi brown, shaded with black. 12 mm.

June and July. Caterpillar dull green; head testaceous with a black spot on each side near eyes, cervical shield of the same color, partly edged below with black; tubercles black; in a slight web between leaves of lupine.

7. **A. agrimoniella** Clemens. Similar to *A. lupinella,* the basal half of the wing powdery ash gray; fascia apparently always complete, and palpi pale. 12 mm.

June and August. Caterpillar between leaves of agrimony; pink when young, later dull green with black tubercles and pale brown head and cervical shield.

New York to Illinois and Georgia. New York: Otto, Taughannock Falls, Sea Cliff, Long Island.

8. **A. tristrigella** Walsingham. Closely similar to *A. agrimoniella* with two or three short, thick, longitudinal white dashes at outer margin, sometimes confluent in a short bar.

Caterpillar on *Corylus americana.*

Connecticut; eastern Pennsylvania; Manitoba.

9. **A. levipedella** Clemens. Antennæ dark brownish; head whitish beneath; palpus with a brown exterior spot on third segment. Fore wing dark brownish, coppery, paler toward base; an oblique white costal patch at middle with a longitudinal dash in fold opposite, and a second more triangular costal streak three-fourths way out, with two longitudinal dashes below it. Fringe with violet iridescence. Below, with white costo-apical dots on all wings. 10 mm. (*Strobisia* Clemens).

June.

Pennsylvania; District of Columbia.

6. *UNTOMIA* Busck

Palpi long, second segment slightly thickened, truncate at tip, third smooth, longer. Fore wing with R_4 and R_5 united, M_3 and Cu_1 stalked. Hind wing about as wide, slightly notched below apex; R and M_1 short stalked; M_3 and Cu_1 connate; cell open.

1. **U. albistrigella** Chambers. Blackish brown, slightly bronzy; a small, oblique, white costal streak before apex, running into fringe, and a few white scales at apex, near dorsal fringe. Fringe pale fuscous with a dark line. Hind wing rather darker. 8 mm. (*Gelechia* Chambers).

June.

Western Pennsylvania; Kentucky.

7. *ANARSIA* Zeller

Palpus of female about like Dichomeris, with third segment hardly as long; in male, with a more or less expansible ridge of long, loose hair on inner side of second segment as well as the triangular tuft of Dichomeris, and third segment

rudimentary, concealed in the vestiture of the second. Fore wing normal; Cu_1 and Cu_2 remote, M_1 out of base of stalk of R_4 and R_5; hind wing trapezoidal, normal, R_5 and M_1 short stalked. The male on account of its rudimentary third joint of the palpus might run to the Phaloniid Tortricids, but is distinguished by the neater triangular palpal tuft, and stalked R_4 and R_5.

1. **A. lineatella** Zeller (Peach bud moth). White, dusted and mottled with gray; palpal tuft blackish on outer side. A couple of black spots on costa of fore wing, and sometimes blackish streaks on disc on R, Cu, fold, and toward tip of wing. 10–15 mm. Female larger (*pruniella* Chambers).

Caterpillar chestnut brown with white incisures, head, cervical shield, and feet black, anal plate black and whitish. It works in the buds and tips of the young twigs of peach and plum in the spring, killing the twigs; the later broods bore in the fruit and eat the stone. (H p. 426 f. 245–6.)

General in distribution; injurious southward, and in many foreign countries; probably introduced from the Old World, where there are several close relatives. New York: Rochester, Lockport, Clifton, Jordan Station, Ithaca, Schoharie.

8. *TRICHOTAPHE* Clemens

(*Begoë* Chambers; *Sagaritis* Chambers [?]; *Dichomeris; Brachmia; Nothris,* in part)

Like Dichomeris, but with second joint of palpus at most only moderately thickened, and usually more strongly so above than below; without a triangular tuft; the third segment apparently arising from its end; palpus sometimes evenly curved as in Anacampsis; more often with the third joint set on at an angle. A slight variant of Dichomeris (fig. 157).

Key to the species

1. Ground color nearly black.
   2. Head and costal edge cream color, contrasting.
      3. Costal cream-colored band sending a curved pointed process into the dark dorsal region ..... 1. *flavocostella.*
      3. With a single broadly rounded process ..... 2. *inserrata.*
      3. With two minute sharp processes ..... 3. *serrativittella.*
   2. Costal edge not light.
      3. With strong iridescence.
         4. A light ochreous dot at apical third of costa ..... 4. *alacella.*
         4. No such dot.
            5. Antennæ thickened, rough-scaled ..... 6. *nonstrigella.*
            5. Antennæ normal ..... 5. *purpureofusca.*
      3. Not iridescent.
         4. Palpi yellow.
            5. Three prominent yellow dots on fore wing ..... 8. *trinotella.*
            5. Yellow dots minute or absent ..... 7. *juncidella.*
            5. A single prominent yellow outer discal dot ..... 7. *leuconotella.*
         4. Palpi blackish ..... 9. *levisella, washingtoniella.*
1. Ground gray, light clay color, or ochreous, without transverse markings.
   2. No heavy black markings on disc.
      3. Fore wing overlaid with dark scales.
         4. An obscure dark and pale postmedial fascia, no longitudinal streaking, terminal line broken into bars ..... 11. *inversella.*
         4. No postmedial fascia, powdering gathering in streaks on veins, terminal line continuous, at least toward costa ..... 10. *chambersella.*
      3. Fore wing at most lightly sprinkled with dark scales.

4. With dark spot on fold.....12. *trimaculella.*
4. No dark spot on fold; head whitish.....13. *fernaldella.*
2. A heavy black V-mark on disc.....14. *setosella.*

1. **T. flavocostella** Clemens. Palpi with second segment loosely hairy on upper
le (Begoë Chambers). Head and palpi light ochre; tegulæ cream white, fore
ng purple-black, with costa cream white almost to apex, narrowing a little at
ddle of wing, and broadening and sending a long spur toward anal angle at end
cell. 15–18 mm.
June and July. Caterpillar on Solidago and Helianthus.
Maryland to Georgia and Missouri. New York: Ilion, Big Indian Valley,
ughkeepsie, New Windsor, New York City.
2. **T. inserrata** Walsingham. Very close to the last species and perhaps a form
it, but with the costal cream colored stripe narrowing more abruptly at middle
wing, and widening roundly over end of cell without any spur. 15 mm.
May to July; Caterpillar in immature fruit of Solidago; olive green.
District of Columbia; Missouri, and elsewhere.
3. **T. serrativittella** Zeller. Similar to *T. flavocostella*, the costal cream stripe
lly as broad, even in width almost to apex, except for two minute teeth, and
en abruptly running to a point just before apex. 10–15 mm. (*plutella*
ambers).
May; July to September.
New Jersey to Florida, Colorado, and Texas.
4. **T. alacella** Clemens. Chocolate brown; palpi and face bright yellow. Fore
ng with terminal margin metallic lead colored or greenish. Costa also lead colored
t to a cream spot before the apex, the area extending down into cell in a tooth
a third way out, narrowed beyond the tooth, and then with a second process
end of cell running across wing to inner margin. Vertex and tegulæ dark.
mm. (*ochripalpella* Zeller; *goodellella* Chambers).
July.
Massachusetts to District of Columbia; west to Missouri. New York: Ithaca;
a Cliff, Long Island.
5. **T. purpureofusca** Walsingham. Purplish black (becoming brownish when
bbed); face paler, steel gray; palpi and tongue bright yellow; immaculate.
ntennæ normal. 18 mm.
June and July.
Ottawa, Ontario, to Wyoming County, Pennsylvania; Manitoba.
6. **T. nonstrigella** Chambers. Antennæ very densely clothed on basal half with
erlapping scales, as in Dasycera. Nearly black; a little iridescent; lower part
face and palpi bright yellow; outer side of third segment blackish. Hind wings
scous as usual but with narrow white costal edge.
June, one brood. Caterpillar spinning together terminal leaves of *Aster shortii*
late April and early May; head black, cervical shield blackish, mesothorax and
nt of metathorax plum-color; rest of body grayish white with seven plum-
lored stripes as wide as the spaces between them. Dorsal tubercles of thorax
larged, black; legs black.
Western Pennsylvania to Kentucky.
7. **T. juncidella** Clemens. Dull purple-brown, with obscure darker postmedial
scia and spot in fold near base. Discal dots (reniform, orbicular, claviform)
ck, sometimes very lightly defined with yellow, and with a few yellow scales on
sta before apex. Palpi and lower part of face contrasting, yellow. 15 mm.
ubitella Chambers).
June to September. Apparently two broods. Caterpillar a leaf-roller on Soli-
go, Aster, Artemisia, and other composites. Head and cervical shield polished
ck; mesothorax velvety black, white on posterior half, with five linear black
rks; rest of body white and obscurely striped, tubercles small, black.

Canada and Maine to Virginia and Kansas. New York: Ithaca, Rhinebeck.

T. leuconotella Busck, a slightly paler species with a single conspicuous, r ocellate, canary-yellow dot at the end of the cell, and a faint light brown cost apical spot, has been determined by Busck from East Aurora, New York. It w described from Washington State.

8. **T. trinotella** Busck. Antennæ dark purple, palpi light ochreous, face ochreo thorax and fore wing brown, prominent ochreous dots at middle of wing, end cell, and in fold; a few ochreous scales at beginning of costal fringe. 15 mm.

May. Caterpillar, apparently of this species, on Œnothera in Missouri.

Western Pennsylvania.

9. **T. levisella** Fyles. Palpi fuscous with third segment paler. Fore wi clouded brown, a little lighter than *T. juncidella*, with a darker postmedial ba tending to break into spots; and an obscure, pale brown, horse-shoe mark at end cell. 15–22 mm.

June and August. Caterpillar folding and crumbling basal leaves of *Ast macrophyllus* in June and eating the parenchyma. Pale green, with darker dors subdorsal, and lateral lines; head and cervical shield glossy black; mesothor brown in front, behind with four conspicuous white patches; tubercles, spirac and leg-plates black. Cocoon capsule-like, open at one end.

Canada; New York.

T. washingtoniella Busck, described from *Ambrosia artemisiæfolia*, and report from the District of Columbia to Missouri, appears to be the same species.

10. **T. chambersella** Murtfeldt. Palpus nearly three times as long as head, s ond segment smooth-scaled above. Outer margin more oblique than usual, near straight. Fore wing clay-color dusted with light fuscous; head, thorax, a palpi concolorous. Fore wing with dusting gathering in blackish streaks betwe the veins; a blackish bar or streak in the cell beyond the middle, and a spot the end of the cell sometimes also drawn out into a streak. Terminal line bla continuous; fringe whitish at base. Hind wing pale gray with whitish fring 9–13 mm. (*inæquepulvella* Chambers).

End of May to September (2 broods?). Caterpillar in a fusiform case, *Ambrosia artemisiæfolia*, webbing together the divisions of the leaf, and eati the upper parenchyma from the inside. Head polished, dark brown; cervical shie small, yellowish; prothorax otherwise dark brown; rest of thorax and third a fourth segments of abdomen brown-black with a white fold on the posterior ed of each segment; first two segments of abdomen wholly black; the rest with oblique anterior lateral band on each segment. Caterpillar making several nes and pupating in the last one.

Western Pennsylvania; Kentucky; Missouri; and south.

11. **T. inversella** Zeller. Second segment of palpus with a large loose tuft upper side; dark gray on outer side; third segment very short, with a black ri beyond middle. Fore wing shaded powdery gray, with a diffuse whitish po medial band. and a longitudinal shade through cell. Slightly diffuse black spo beyond middle and at end of cell, and near base and middle of fold; costal ed blackish at base. 18 mm. (*Epicorthylis* Zeller).

Texas (doubtful northward). There is a related but much smaller speci known from Maryland and Virginia in June.

12. **T. trimaculella** Chambers. Palpus with third segment only half as long second. Pale yellowish, minutely and sparsely dusted with reddish ochreous; he and palpi nearly white; third segment of palpus tinged with fuscous. Two sma nearly round, blackish spots at middle of wing, obliquely placed in fold and cell, larger one at end of cell, and a minute terminal series. 12 mm.

April and May. Almost identical with *Dichomeris touceyellus*, except for t smoothish Trichotaphe palpus with short third joint.

District of Columbia to Texas.

13. **T. fernaldella** Busck. Palpus very long, second segment smooth on dorsal ide. Cream white, including head and palpi. Fore wing lightly dusted with ight dull gray between the veins, which stand out pale. A small blackish spot eyond middle and one at end of cell, sometimes with a few blackish scales in old below the first. Outer margin strongly oblique. 18 mm.

June. Very similar to *T. chambersella* but paler and much larger; also easily onfused with the Gelechias if the palpi are not noted.

Orono, Maine; Adirondacks; Manitoba. New York: Peru.

14. **T. setosella** Clemens. Almost exactly similar to *Dichomeris eupatoriellus.* uscous gray; a costal cream-colored stripe, gradually narrowing to postmedial ine, where it runs out. Postmedial line yellow, slightly concave, edged beyond ith a blackish shade. A very heavy and widely open V-shaped mark in cell and old from close to base almost to middle of wing, filled with an extension of the ream-colored costa. 18 mm. (*Malacotricha bilobella* Zeller).

July and August.

General and not rare. New York: Ithaca; Sea Cliff, Long Island.

8½. *BRACHMIA* Hübner

Similar to Trichotaphe. Fore wing with R_2 shortly stalked with R_{4+5}. Palpi ng, upcurved, and moderately thickened.

1. **B. hystricella** Braun. Brownish ochreous or fuscous. Face straw-colored; alpi with two fine longitudinal lines. Antennæ dark, banded beneath with whitish. ore wing with veins distinctly outlined with pale straw color, costal and inner argins, and a streak in cell also whitish. Ordinary spots black, outlined with hite, the one corresponding to the claviform elongate. Costal fringe straw-colored, orsal fuscous, contrasting. Terminal line blackish, fringe with two dark lines. ind wing yellowish white or light gray. 14 mm.

Several broods a year; larvæ in rolled leaves of *Hystrix patula.* Larvæ of the st brood wintering in the rolled leaves. Larva with head brownish ochreous, he lateral margins dark reddish brown; prothorax whitish, with a continuation f the lines of the head; next four segments dark brown, the anterior edges of he first two whitish; rest of body whitish with a brown, subdorsal line and blique lateral stripes.

Cincinnati, Ohio.

9. *DICHOMERIS* Hübner

(*Ypsolophus* auct., not Fabricius; *Nothris* auct., etc.)

Palpus with a prominent triangular tuft on ventral side of second segment, xtending beyond the attachment of the third, which is longer than the second ithout its tufts, and slender. Fore wing long, normal; R_4 and R_5 stalked, Cu_1 nd Cu_2 stalked, the other veins free. Hind wing with R and M_1 approximate or ortly stalked; M_3 and Cu_1 connate or stalked; M_2 associated with Cu-stem.

Key to the species

1. Fore wing very long and narrow (over four times as long as wide); hind wing bluish, translucent between the veins.....1. *ligulella.*
1. Fore wing usually about three times as long as wide and always less than four; hind wing fully scaled.
2. Fore wing with dark dorsal spot two-thirds way out.....8. *citrifoliella.*
2. No dark spot two-thirds way out on inner margin.
3. Two large black spots on disc.....11. *eupatoriella.*
3. No large black spot on disc.
4. Margins concolorous with the ground.

5. Usual discal dots distinct (reniform and claviform at least).
6. These dots light brown.....2. *punctidisce*
6. These dots not light brown.
7. Head and outer and inner margins blackish, more or less c trasting .....7. *vaccinii*
7. Head not contrastingly blackish.
8. Ground red-brown with coarse paler (pinkish) powdering. 6. *trinote*
8. Ground not red-brown.
9. Expanse about 12 mm.
10. Ground rather light brown with blackish dusting; bl terminal bars.....(*Anorthosia punctipennel*
10. Ground blackish brown.
11. Scattered black scales only in fringe.....3. *touceye*
11. Regular blackish bars in base of fringe.....4. *hirculo*
9. Expanse about 20 mm.
10. More or less distinct longitudinal streaks...5. *bipuncto*
10. Not streaked .....10. *ventrella, georgia*
5. No distinct discal spots.....9. *caryæfolie*
4. Margins pale, contrasting.....12. *margine*

1. **D. ligulella** Hübner. Fore wing about four and a half times as long as wi hind wing notably shorter, with disc translucent; bluish between veins, the sc reduced and not meeting each other. Fore wing normally fuscous brown, with di dots and postmedial band normally somewhat darker, but sometimes obsolete. H wing bluish, with fuscous brown veins. 15 mm.

This is var. **pometella** Harris. In the typical form the costa is broadly crea white, contrasting with the ground color. (The names *Chætochilus contubernatel* Fitch, *pauciguttellus* and *flavivittellus* Clemens, and *reedella, ruderella,* and *q cipomonella* Chambers, mostly represent variant forms.)

Common and generally distributed; often in injurious numbers on apple (Palmer-worm) but sometimes rare for years together. Caterpillar green, less o brown, head yellow-brown, black-brown in dark specimens; cervical shield con orous with head, often heavily marked with black in dark specimens. Tuber black; body with a narrow dorsal and very broad subdorsal diffuse dark ba separated by whitish stripes. A leaf-roller on apple and oak.

New York: Genesee County; Geneva, Rock City (Cattaraugus County), Ith Nassau, Byron, Albany.

D. malifoliella Fitch, of which no material is known to exist, is probably a fo of *ligulella.* It was described from New York.

2. **D. punctidiscella** Clemens. Obscure fuscous, varying in shade, with four bro brown transverse bands, the second formed by the rounded orbicular and clavif spots, the third including the discal bar. Hind wing fuscous, very slightly tra lucent between the veins. Wing about three and a half times as long as w Second segment of palpus black on outer side, finely edged with white; third p ochreous; antennæ annulate with pale yellowish brown and deep brown; head li yellowish. 18 mm.

End of May to June.

Parry Sound, Ontario, to District of Columbia and Ohio. New York: Taug nock Falls (Ithaca).

3. **D. touceyella** Busck. Palpi as in *D. punctidiscellus;* head and thorax p ochreous, densely dark-dusted. Fore wing ochreous, dusted and suffused w brown; a small dark brown spot on fold before middle, and larger ones at mid and end of cell. Some scattered dark scales at base of fringe. 12 mm. (*Ana trimaculella* Chambers, not Clemens.)

Kentucky; Texas.

4. **D. hirculella** Busck. Wing form as in *touceyella*; hind wing fully scaled. Palpus with second segment blackish on outer side, third ochreous. Fore wing ochreous, heavily dusted and mottled with black scales,— in effect, blackish fuscous; and with blackish spots in cell, at end of cell, and sometimes a postmedial series of smaller ones. Fringe yellower with blackish bars in base. Hind wing lighter fuscous. 11–12 mm.

East River, Connecticut.

5. **D. bipunctella** Walsingham. Dull brownish yellow. Discal dots well marked; terminal points each at end of an obscure grayish streak, rarely obscure. Veins sometimes distinctly streaked. 22 mm.

April to July.

Digby, Nova Scotia, to Florida, along the coast. Hazelton, Pennsylvania.

6. **D. trinotella** Coquillett. Head pinkish brown; palpus with second segment dark brown on outer side; tuft tipped with pale pinkish; third segment dark brown. Antennæ annulate; fore wing reddish brown, inclining to pink; sparsely and coarsely dotted with black; often with three white spots near its center, the outermost spot crossed by a black dash, the other two edged within with black, sometimes with only the black spots. Hind wing dull leaden. 11 mm. (*Nothris* Coquillett.)

Caterpillar on hazel, in a folded leaf.

Illinois.

7. **D. vacciniella** Busck. Tuft of palpus dark brown, its apex sprinkled with white; third segment light brown, dusted with black, base white externally. Head blackish. Fore wings wood-brown, shaded with dark brown on outer and inner margins, and sparsely and irregularly strigose with black scales; three small, round, black, white-ringed dots, or a few white scales at middle and end of cell and in fold before the first dot; apex suffused with purple-black, becoming black at margins; fringes dark fuscous, with light ochreous brown tips; thorax concolorous. 15–20 mm.

Larva on cranberry.

Pemberton, New Jersey.

8. **D. citrifoliella** Chambers. Ochre yellow, densely and evenly dusted with gray. Palpus blackish, with tuft white tipped; third segment yellow. Thorax below, shoulders, and costal edge at base, black. Fore wing with two antemedial dark dots above and below fold; two dots in cell, in position of orbicular, and one dot in fold just beyond them; a pair of blackish discal dots and a stronger blackish shade on inner margin beyond them; postmedial line faint, pale, defined with dark, irregular. Hind wing gray. 18 mm.

June. Larva yellow with black head and cervical shield; a leaf-roller and budworm on citrus and prickly ash; sometimes injurious to orange in the South.

Cincinnati, Ohio, and south.

9. **D. caryæfoliella** Chambers. Palpi as usual; head and thorax golden or reddish iridescent, suffused with fuscous; fore wing iridescent, silky, suffused, showing golden, red-brown, and lead color; two or three minute dots on disc. Hind wing lead color. 22 mm.

End of June. Caterpillar green with six interrupted longitudinal white stripes. Head ferruginous; prothorax brown; true legs black. Sewing together leaves of hickory in early June. At maturity it turns white, striped and suffused with pink.

Missouri; Kentucky; Texas.

10. **D. georgiella** Walker. (1866). Varying in color from light yellowish to dark purple-brown, dusted with a darker shade, and with scattered black scales. Costal edge pinkish, sometimes very narrowly; outer margin sometimes suffused with pink. With antemedial, median, and discal dots, which sometimes run together into three darker bands, parallel and slightly oblique inward. Orbicular and claviform in the median band; almost always with some white scales; also with some

white scales, occasionally wanting, on inner side of discal dot. Fringe yellowe hind wing mouse gray. 17–20 mm.

May to July. Larva a leaf-roller on oak, skeletonizing the leaf. (Describe from the same material as type of *D. roseocostella* Walsingham.)

Distribution apparently general.

D. ventrella Fitch (1854) appears to be the same species, so far as can be to from the description; and in that case would have priority (*unicipunctel* Clemens).

"New York" (Fitch).

11. **D. eupatoriella** Chambers. Male with a large expansible tuft, normall hidden behind fore coxa. Dull purplish gray or fuscous; costa whitish an lightly dusted with dull black, somewhat less contrasting than in *Trichotapl setosella.* Blackish patch on cell and fold of fore wing not quite reaching midd of wing; its front edges with sharp angles near its tip and halfway between the and base of wing, with a *right angled* emargination between; shorter than i *setosella.* Postmedial line, whitish, fine, and nearly erect; the wing darkene beyond it to outer margin. 16 mm. (*dolabella* Zeller, *setosella* Walsingham, n Clemens.)

May to July; late September. Caterpillar on *Eupatorium ageratoides* and Ve nonia, when on the former plant folding a leaf so that a large side vein lies again the midrib; greenish white. July.

New York to Florida and Manitoba. New York: Crosby (Yates County).

12. **D. marginella** Fabricius, a pale even pinkish brown species, with the fo wing margined all around with cream color, has been introduced from Euro at Westchester, Pennsylvania, and at Tarrytown and Plandome, New York. Larv on *Juniperus communis,* social in a web; brown, longitudinally striped. (*Nothr* auct.)

10. *GLYPHIDOCERA* Walsingham

(With *Sceptea* Walsingham)

Similar to Trichotaphe; palpus with second segment not swollen, evenly upturned fore wing (fig. 161) with R_4 and R_5 completely united, and often stalked with M_1 or M_1; Cu_1 and Cu_2 stalked, M_3 occasionally arising from the base of their stalk typically nearer M_2. Male antenna in some species with a notch in the shaf near the base, edged with rough scales, and running obliquely across severa segments. Obscure ochre yellow species, dusted more or less heavily, with th ordinary dots alone indicated by a gathering of the dusting. *G. lactiflosella* onl is pale yellow without dusting.

Key to the species.

1. R_3, R_{4+5}, and M_1 all free.
   2. Antenna strongly notched; ground dull ochreous.....2. *æquepulvell*
   2. Antenna simple; ground cream color.....1. *lactiflosell*
1. R_3 short-stalked with R_{4+5}; notch rudimentary or absent.
   2. M_3 stalked .....5. *dimorphell*
   2. M_3 free.
      3. Antennæ annulate with black; a moderately powdered species. 4. *meyrickell*
      3. Antennæ annulate in two shades of light brown.....3. *speratell*
1. R_{4+5} stalked with M_1.....6. *aberratell*

1. **G. lactiflosella** Chambers. Cream color. Thorax with three dark dots behind palpus simple; second segment dark on outer side, except apex. Fore wing wit a dot in base of fold, an antemedial dot in fold, dots opposite each other a middle of wing in cell and fold, sometimes fusing into a bar, and a bar at en of cell, all brown. Terminal line brown, at apex only. Ground lightly duste with brown. 12 mm. (*Trichotaphe*).

It flies in Louisiana in June.
Texas; Louisiana; Plummer's Island, Maryland.

2. **G. æquepulvella** Chambers. Fore wing with all veins well separated except u_1 and Cu_2; male antennæ with notch cutting nearly halfway through stalk. ight dull ochre, dusted with fuscous in about equal proportions. Palpus with ird segment darker; head and thorax pale. 14 mm.
Virginia; Kentucky; Texas; Colorado; and Utah.

3. **G. speratella** Busck. Fore wing with R_{4+5} stalked with R_3. Antennæ light hreous, in male with a slight indication of notch. Palpi slightly sprinkled with iscous externally, face and head light ochreous. Fore wing thickly and evenly rinkled with fuscous, and with four darker dots (the usual three and one near ise). 18 mm.
Western Pennsylvania.

4. **G. meyrickella** Busck. Palpi ochreous, third segment slightly scaled with lack on inner side; antennæ light ochre, annulate with black, simple. Fore wing enly and profusely dusted with black scales, sometimes mostly fuscous, with ie usual discal dots but no terminal dots. Venation as in *G. speratella*.
June in the South.
Maryland and to Louisiana and Mississippi. New York: Ithaca.

5. **G. dimorphella** Busck. R_{4+5} stalked with R_3 and M_3 with Cu_1 and Cu_2. Palpi llow, lightly mottled with black scales; antennæ yellowish fuscous, not strongly nulate, and without notch. Head and thorax clear straw yellow; fore wing ght straw yellow, lightly dusted with black, with two blackish discal dots in ll and a well-marked terminal series. 10–11 mm.
Maryland.

6. **G. aberratella** Busck. *Fore wing with* R_{4+5} *stalked with* M_1, *forking over ex;* M_3 free (**Sceptea** Walsingham). Antennæ dark fuscous and simple in both xes. Head and thorax dark; palpi heavily dusted; fore wing heavily overlaid ith fuscous scales, especially along edges and toward apex. The usual discal ts nearly covered over. 14 mm.
June.
Maryland; Virginia; Missouri.
There is an undescribed species from New York, near *aberratella*.

11. *ANORTHOSIA* Clemens

Male antenna with a deep oblique notch in shaft near base, the segments before much thickened. Palpi with a triangular tuft on second segment as in Dichneris, but hardly as broad at tip, and in male with a large expansible tuft above. ore wing as in Trichotaphe and Dichomeris, Cu_1 and Cu_2 strongly stalked; outer argin oblique. Hind wing hardly as wide as fore wing, with apex more drawn out an in Dichomeris.

1. **A. punctipennella** Clemens. Rather dark ochreous. Palpi dark brownish ternally; antennæ sharply annulate with dark brown. Ordinary spots dark, mewhat diffuse, contrasting, and with an additional antemedial dot or pair dots. Fringe ochre yellow, with a series of black bars in its base. Hind wing ayer. 12 mm.
June and July.
Distribution general, north to Pennsylvania. New York: Taughannock Falls, haca.

12. *STROBISIA* Clemens

Similar to Trichotaphe; palpi smooth, third segment as long as second or longer, th smooth and slender. Fore wing typically with R_4 and R_5 united, long-stalked *emblemella* (subgenus **Holophysis** Walsingham), Cu_1 and Cu_2 stalked. Hind wing

trapezoidal, without decided produced apex; hardly as wide as fore wing; R a
M_1 connate. Fore wing with metallic markings.

An exotic species has been bred from a fungus bed in a termite nest.

Key to the species

Narrow blue dots and dashes.....*irridipenne*
Broad spots and bands.....*embleme*

1. **S. emblemella** Clemens. Fore wing brown-black, with steel-blue markin
a basal band, and antemedial band from costa across cell, a very irregular, narro
medial band, partly fused with the discal dot and forked toward inner margin
costal spot four-fifths way out to apex, and a subterminal band reaching t
thirds way to costa and very irregular on outer side. The bands easily become dul
in old specimens. 9 mm.

June and early July. Caterpillar possibly on buckeye.

Western New York to District of Columbia, southern Ohio, and Kentucky. N
York: Rock City (Cattaraugus County), Taughannock Falls (Ithaca).

2. **S. irridipennella** Clemens. Shining deep brown. Fore wing marked with bri
iridescent blue. A strongly oblique line from costa a fourth way out across
and fold; a slightly more erect median line running into cell, and a longer
almost three-fourths way to apex. A short bar four-fifths way out and a
on inner edge near middle; the longer lines sometimes broken into dots (ab
10 in all). 10 mm. (*aphroditeella* Chambers, *proserpinella* Frey.)

June to August.

District of Columbia to Missouri. New York: Robinson Collection (presuma
from New York).

13. *DUVITA* Busck

(*Anacampsis, Aproœrema, Untomia,* in part; with *Battaristis* Meyric

Similar to Stomopteryx and Anacampsis. Palpus with second joint smoot
thickened and abruptly cut off, third slightly thickened. Fore wing normal,
not stalked, M_3 and Cu_1 sometimes stalked, typically free. Hind wing about
wide as fore wing, trapezoidal, with somewhat produced apex; R and M_1 stalk
M_3 and Cu_1 connate, discocellular vein imperfect. Palpus shorter and hind w
less produced than in Stomopteryx. Fore wing in all our species with a bl
dot immediately below the apex as in *Epithectis subsimella.*

Key to the species

Deep rust-red, banded with gray.....1. *vittel*
White shaded with luteous.....2. *nigratomel*
Light fuscous.
A straight, oblique, white postmedial line.....3. *concinusel*
A curved, and often obscure, postmedial line.....5. *conclusel*
Dark smoky gray.....4. *tahavusel*

I. *Apex of hind wing strongly produced* (Duvita).

1. **D. vittella** Busck. Palpus with second joint black-brown outwardly, tip
with white; third whitish with broad black annulus; head and thorax whit
fuscous; face pale. Fore wing bright brown with white bands, strongly dust
with steel gray, much as in *Paralechia pinifoliella,* but without tufts; basal h
of costal edge dark brown; two transverse gray and white fasciæ, the medi
one strong, defined on basal side; outer margin and apex also gray and whi

with a black dash at middle of outer margin. Terminal line black, white-edged; fringe gray, white-tipped. 10–11 mm.

Larva in "stunted cones" of Scotch and Austrian pine, and in "Cecidomyid gall" on *Pinus tæda*.

Long Island, New York; Maryland.

2. **D. nigratomella** Clemens. Head whitish; antennæ pale yellowish; palpi with second joint fuscous on outer side except extreme tip, third with fuscous outer line. Fore wing clay color, basal two-fifths of costa white, outer part alternately barred black and white, with a long, nearly longitudinal, black dash at middle of costa. Postmedial line white, straight, oblique outward, fading out below middle of wing near apex. Apex white, with a black spot below it. Hind wing a little darker. 9 mm. (*apicistrigella* Chambers, *apicilinella* Clemens).

May to July.

New Hampshire to Virginia and Colorado. New York: Rock City (Cattaraugus County).

3. **D. concinusella** Chambers. Evenly dull gray, head and costa paler, antennæ blackish; postmedial line white, the upper half as in the last species, then turning a right angle and running into inner margin, with white dots on costa and outer margin near apex, and traces of oblique white striæ at middle of costa, all defined with dark. Apical dot in a gray shade. 9 mm.

Pennsylvania; Colorado; and Texas. New York: Rock City (Cattaraugus County).

4. **D? tahavusella**[21] Forbes. Antenna with a single bristle on scape, representing a pecten. Ædœagus simple, spine-like. Palpus with second segment thickened, but hardly brush-like; third decidedly longer. Hind wing with strongly produced apex. Fuscous; inner side of palpus, scaling of tongue, and lower part of face pale. Fore wing with scale-bases pale, but hardly showing in a fresh specimen; with a whitish, diffuse, subterminal spot on costa, and a fainter one opposite it on inner margin. Hind wing light gray, with fuscous fringe. 10 mm.

June 8, 10; July 10.

New York: Uphill Brook (Mt. Marcy), Peru (Adirondack Foothills).

II. *Apex not produced, hind wing trapezoidal* (Battaristis).

5. **D. conclusella** Walker. Gray, variable in shade, often shading into blackish before the postmedial line, and heavily shaded with white. A fair proportion of scales white-tipped. Antenna blackish, annulate with white, the outer third with annulations on alternate segments only. Palpus with a black bar or two on third segment, and second segment fuscous. Fore wing with a slender black dash along middle of costal edge, and another at origin of postmedial line. Postmedial line strongly curved out on upper half, then sinuous or obscure to inner margin. Terminal dots often strong, the dot below apex often obscure, or only slightly larger than the other terminal dots. Hind wing with apex marked but not extended, **R** and M_1 very shortly stalked or approximate; M_3 and Cu_1 of fore wing occasionally stalked. 9 mm.

June to August.

Canada to Pennsylvania. New York: Peru, Rock City, Ithaca.

14. *STOMOPTERYX* Heinemann

(*Aproœrema* Durrant; *Anacampsis* auct.)

Palpi smooth, slender, with third segment longer than second. M_1 shortly stalked with R_4 and R_5 in fore wing (fig. 156), the other veins free; hind wing narrow, apex produced, **R** and M_1 stalked, M_2 free, associated with **Cu**-stem. This

[21] Tahawus is the Indian name for Mt. Marcy.

genus is derived from the similarly marked group of Anacampsis, and differs mainly in the reduced hind wing. Duvita is a parallel development.

Key to the species

1. Third joint of palpus longitudinally striped with white.....1. *palpilineella,*
1. Third joint of palpus not striped.
2. Fore wing with a curved white fascia at middle.....2. *kearfottella.*
2. Fascia two-thirds way out to apex, or obsolete.....(1) *nigrella.*

1. **S. palpilineella** Chambers. Fore wing, head, and body dull black; extreme tip of second joint of palpus white, third joint jet black with fine, often broken, white stripes. Sometimes with traces of a pale postmedial line at costa and inner margin. 8 mm.

August. Caterpillar folding leaves of red clover.

New Jersey to Missouri and Louisiana.

A. nigrella is probably western only (east to Kansas). It is very like *A. palpilineella,* but with the palpus not striped.

2. **S. kearfottella** Busck. Purplish black; antennæ annulate with white; palpi silvery white, third joint dusted with fuscous, darkening to tip. Face white; fore wing with a slightly excurved median white fascia. Fringe white-tipped at middle. Hind wing slightly duller. Tibiæ silvery white; femora black; tarsi dusky.

July.

New Jersey.

15. *POLYHYMNO* Chambers

(*Copocercia* Zeller)

Palpus with second segment hardly thickened, third much longer. Fore wing narrow, rather oblong, caudate, the fringe strongly concave above and below the long-drawn-out apex. R_4 and R_5 very long-stalked in our species; hind wings narrower, apex much drawn out and almost caudate, R and M_1 long-stalked, M_3 and Cu_1 short-stalked, M_2 low, discocellular vein weak. Larva on Leguminosæ. The genus also occurs in Africa.

1. **P. luteostrigella** Chambers. Silvery white, thorax with four longitudinal golden brown lines; fore wing with three brown lines from base to apex, and some oblique ones at apex of costa, converging at apex of wing, and with anastomosing dorsal lines, leaving inner margin white; dorsal fringe yellow. 9 mm. (*fuscostrigella* Chambers).

August.

Connecticut to South Dakota (Upper Austral Zone) and south.

16. *PARALECHIA* Busck

(*Gelechia, Aristotelia,* in part)

Palpi with third segment only three-fifths as long as second, blunt at apex; fore wing (fig. 165) with three pairs of raised tufts; M_1 free; M_2, M_3, and Cu_1 long, approximate; Cu_2 shorter and distant; with a reniform area of blackish sex-scaling on under side, in male. Hind wing three-fourths as wide; long-trapezodial; outer margin a little waved; R and M_1 very slightly divergent; M_2 cubital; M_3 and Cu_1 almost connate, or stalked.

1. **P. pinifoliella** Chambers. Shining deep yellow-brown; inner edge of fore wing toward base, apex and apical fringes, and three bands, dividing the wing into equal parts, white, dusted with gray; the bands rarely broad and suffused; the

raised tufts on inner edge of bands, black. Outer band narrowest and paler. No apical dot. Hind wing fuscous. 9 mm.

June. Caterpillar a leaf-miner in pine needles.

General in distribution and common. New York: Round Lake, Ithaca, Karner.

17. *AROGALEA* Walsingham

(*Paralechia*, in part)

Hardly distinct from the European genus Stenolechia. Palpi with third segment as long as second, and acute; second segment rough-scaled. Fore wing dull, with slight raised tufts in fold at one-fifth and three-fifths way out, easily lost. Venation much like Paralechia; hind wing with apex a little drawn out; R and M_1 well separated at origin, but strongly divergent; M_3 and Cu_1 shortly separated at origin.

1. **A. cristifasciella** Chambers. White, palpus with four blackish bands, fore wing with black dots near base. Black antemedial fascia from costa obliquely inward to inner margin, including first tuft; black postmedial spots beyond middle (the dorsal one including the second tuft); and some minute black dots. Hind wing yellowish. 13 mm. (*inscripta* Walsingham).

April; July. Caterpillar on oak, skeletonizing leaves from under side, or inquiline in galls.

General in distribution. New York: Crosby (Yates County).

18. *TELPHUSA* Chambers

(*Xenolechia* Meyrick)

Closely related to the tufted *mediofasciella* group of Gelechia, and derived from it. Fore wing (fig. 163) similar to Gelechia, usually with raised tufts; hind wing as in Gelechia, except that M_3 and Cu_1 are well separated at origin; palpi as in Gelechia. The species average smaller than Gelechia.

Key to the species

1. With contrasting, oblique, white or whitish fascia at basal fourth.
   2. Fascia narrower, outer half of inner edge white.....1. *longifasciella.*
   2. Fascia broader, inner edge not white.....2. *latifasciella* (part).
1. No contrasting white fascia.
   2. Ground color of fore wing white, not heavily dusted with gray.
      3. Markings black; antemedial fascia stopping at fold.....8. *basifasciella.*
      3. Markings fawn-colored, diffuse.....9. *betulella.*
   2. Ground color of fore wing not white, or else heavily gray-dusted.
      3. Nearly black .....3. *quinquecristatella.*
      3. Gray, often powdery.
         4. An oblique black antemedial fascia, marked by two raised scale-tufts, and often broken below costa.
            5. A broad lighter antemedial fascia, completely defined on both sides, and contrasting with the blackish base.....2. *latifasciella*, in part.
            5. Antemedial fascia defined toward base only, and of the same shade as ground color and base.
               6. Head and thorax light fuscous, not powdery..7. *palliderosacella.*
               6. Head and thorax, like fore wing, heavily dusted with blackish on pale gray or white.
                  7. Fore wing dusted with purple-black on white; antenna annulate with white .....6. *querciella.*
                  7. Fore wing less contrastingly dusted, and more heavily tufted; antenna gray .....4. *quercinigracella*, 5. *fuscopunctella.*

4. No oblique antemedial fascia; wings smoothly scaled.
5. A sharply defined blackish spot on fold near middle..11. *glandiferella.*
5. No such spot.
6. Palpus with third segment yellowish; brown shades on fore wing. 10. *belangerella.*
6. Palpus with third segment pure white; fore wing dusted with black and gray on a pearl-white ground...(*Glauce pectenalœella*).

1. **T. longifasciella** Chambers. Dark purple-brown. Head white; palpi purplish with white annuli on third segment at base and end; fore wing with a white fascia from costa near base, running obliquely across to inner margin, then along inner margin almost to apex, but constructed or interrupted at anal angle. 15 mm. (*curvistrigella* Chambers, *obliquefasciella* Chambers).

April and May.

New York to Oregon and Texas. New York: East Aurora, Crosby, Ithaca.

2. **T. latifasciella** Chambers. Powdery gray, the base blackish; a broad paler (typically white) antemedial fascia, as wide as breadth of wing, edged on both sides with raised black lines. An irregular postmedial line, weak or broken in middle, with a whitish shade beyond it toward costa, and typically a large white patch between it and end of cell; a double black tuft at end of cell. 13 mm.

May. Larva on oak; a leaf-roller.

Massachusetts to North Carolina and Missouri.

3. **T. quinquecristatella** Chambers. Deep brown, with a little purple iridescence; face dusted and shaded with whitish; palpi light powdery gray, with black bars; legs dark brown with white bars. Fore wing with three pairs of somewhat darker tufts; the anterior of each pair a little farther out, and each with some white-tipped scales; apical region dusted with white, indicating the postmedial line at the margins. No black spot at base of costa. 16 mm.

May; July; October. Larva a bud worm on huckleberry. Slender; yellowish white; head and cervical shield pale yellow; body showing the green dorsal vessel. What is apparently the same thing also occurs on Comptonia.

Generally distributed eastward.

4. **T. quercinigracella** Chambers. Powdery gray: palpi and antennæ also banded in two shades of gray; fore wing with a heavy black bar from costa to fold near base, nearly interrupted in middle, and containing two large tufts. Black basal spots at costa and in fold; a black spot at middle of costa, with an oblique spot in cell and a streak in fold opposite; a black postmedial spot on costa, connected to a similar spot in fold by the black discal bar. Apex blackish, with an obscure, sinuous, pale, postmedial fascia. Fringe powdery gray. 12 mm.

Caterpillar on black-jack and other oaks, in late June and July. White with a black bar on each side of head; a yellow cervical shield with black posterior edge and black tubercles; at maturity developing red transverse bands on the middle of the segments.

Generally distributed. New York: Ithaca.

5. **T. fuscopunctella** Clemens. Very closely related to the last species and indistinguishable when rubbed. Antemedial band usually broken, the tuft nearer costa being weak and well separated from the other; ground slightly paler, and base more contrastingly marked.

Caterpillar with *T. quercinigracella*, similar to it, but with two ocellar dots on each side of head instead of a single bar, and incisures instead of mid-segments striped with red at maturity.

Pennsylvania and District of Columbia.

6. **T. querciella** Chambers. Very close to *T. quercinigracella*; ground whiter, antennæ and palpi more distinctly ringed with white; posterior tuft of thorax yellow. Fore wing marked as in the last two species; a large proportion of scales white, with a gray bar only. 12 mm.

Early June. Caterpillar whitish; head, cervical shield, and tubercles purplish brown; body with fine purple addorsal and broader subdorsal lines. A leaf-roller on oak in May. These three species are practically indistinguishable without breeding.

New Jersey; Kentucky.

7. **T. palliderosacella** Chambers. Similar to the last three species but with more purplish tint. Head hardly powdery, and pale in front. Fore wing with ground a light rather *pinkish fuscous*; the black spots on the costa as in *quercinigracella*, and antemedial bar strong, but tufts small, sharply defined, black, and well separated. 13 mm.

Larva in oak, sometimes inquiline in galls.

New York to Texas. New York: Rock City (Cattaraugus Co.).

8. **T. basifasciella** Zeller. White; fore wings with a little gray dusting, palpi with two gray bands on second, and stronger ones on third segments; antennæ blackish. Fore wing with a black bar from costa at a fourth way out, running obliquely outward to below fold and connected along costa to base; black spots on costa before and beyond middle, with a dark gray spot on inner margin opposite the outer one; a black discal dot and bar, and heavier gray dusting at outer margin. Hind wing dirty white. 10–12 mm.

May to June; late July. Caterpillar on oak, skeletonizing the leaves from the under side.

New Hampshire to Missouri and Texas.

9. **T. betulella** Busck. White, mottled with pale pinkish brown; antennæ annulate with white, and pale and dark brown; fore wing with three obscure and broken oblique transverse fasciæ, including the large concolorous basal tuft, and with smaller outer ones; base of costa black. Fringe and hind wing whitish. 12 mm.

August; early spring. Caterpillar in a rolled leaf of black birch, pupating in the roll.

District of Columbia; Virginia.

10. **T. belangerella** Chambers. Fuscous, powdered on a slightly pinkish white ground, with slightly raised brown bars on disc, and a brown streak on fold. Terminal dots dark, obscure, diffuse. Antennæ and legs brown; palpi with second segment pale gray, third yellowish with brown rings. 14 mm. (*oronella* Walsingham).

May to July. Caterpillar a leaf-roller on alder.

Canada; eastern United States.

11. **T. glandiferella** Zeller. Pale, hardly powdery, ochreous gray; a velvety, sharply defined, dark brown spot in fold near base; a larger dark brown spot on fold, or typically, a bar reaching to inner margin, beyond it; and usually a small dot at end of cell: each spot lightly defined with paler brown. 12 mm.

July to September.

East River, Connecticut, to Kansas and south.

19. *GLAUCE* Chambers

Closely related to Telphusa, and probably a development of it. Palpus with second segment somewhat thickened, but nearly smooth, third segment longer; fore wing with R_4 and R_5 stalked, M_1 normally stalked more or less with R_5, sometimes to well beyond origin of R_4, as in the Sitotroga group, rarely free, connate. M_2 connate with M_3 and widely separated from M_1, even at margin; Cu_1 long and parallel to M_2, M_3, and Cu_1. Hind wing with R and M_1 stalked, approximate, or widely separated, apparently varying locally; M_2 twice as near M_3 as M_1. M_3 and Cu_1 separate. *Male with a very large tuft of black bristles* (fig. 166) projecting forward from front of hind wing, attached below Sc; the venation distorted; and with costal edge clothed with much-enlarged scales.

1. **G. pectenalæella** Chambers. Black, heavily powdered on a white base; head and thorax almost solid black; antennæ black, with a strong white ring at tip of scape; fore wing mottled gray and black, without definite markings. 7 mm.

July; June, southward.

New York and District of Columbia to Kentucky and south. New York: Rock City (Cattaraugus County).

20. *AUTONEDA* Busck

(*Neda* Chambers, not Mulsant)

Palpus with a very short, triangular tuft on under side of second segment; third as long, slender. Fore wing with M_1 approximate to R_{4+5}; M_2 separate; hind narrower than fore wing, with M_2 nearer M_1 than M_3; apex produced.

1. **A. plutella** Chambers. Brownish black; palpi above, head, thorax, and inner margin of fore wing, cream white; shoulders black, shading into cream white; costa white; fringe cream white except at apex. 11 mm.

September. Type only seen.

Kentucky.

21. *ARISTOTELIA* Hübner

(*Ergatis* Heinemann, with *Eucatoptus* Walsingham)

Palpi small, often quite rough. Fore wing broad, lanceolate (fig. 164). M_1 free; M_2 and M_3 occasionally stalked; the other veins free. Hind wing falcate, with produced apex; cell large; R and M_1 divergent but widely separate at base; M_2 nearer M_1 than M_3; M_3 widely separate from Cu_1. Hind wing narrower, sometimes much narrower, than fore wing. Male sometimes with a costal hair-pencil on hind wing, not disturbing the veins (**Eucatoptus**).

The palpi in this group are strongly divergent, and the patterns described are those of the inner face; the outer face is usually similar but with a little more black.

Key to the species

1. Ground bright cinnabar red.....6. *salicifungiella.*
1. Ground not dull red (sometimes suffused with pink).
  2. Ground nearly even, with small markings.
    3. Ground white or yellowish to dull wood-brown.
      4. Five black marks on disc.....14. *quinquepunctella.*
      4. Not so marked.
        5. A light yellow or cream-white streak running from costa at beginning of fringe.
          6. Palpus with second segment and basal half of third segment black . 15. *robusta.*
        6. Palpus less extensively black.
          7. Apex of palpus black; a paler species.....13. *angustipennella.*
          7. Apex of palpus not black.....12. *gilvolineella.*
        5. No light costo-apical streak.....11. *disconotella.*
    3. Ground black or fuscous.
      4. Fifth and tenth joints from apex of antenna white above. 8. *absconditella.*
      4. Antennæ without white joints
        5. With subterminal dots.....9. *minimella.*
        5. No subterminal dots.....10. *physaliella.*
  2. Fore wing broadly and contrastingly marked in two or more colors.
    3. With metallic markings.

4. Base of fore wing white.....7. *elegantella.*
4. Base of fore wing greenish black.....(*Enchrysa dissectella*).
3. No metallic markings.
4. Fore wing with dark fascia at apical third.....3. *molestella.*
4. No such fascia; usually roseate.
5. With pure white costal markings.....1. *roseosuffusella.*
5. No pure white markings.
6. A costal hair-pencil at base of hind wing.....2. *rubidella* (male).
6. No costal hair-pencil.
7. Fore wing strongly suffused with pink; third joint of palpus with dark base and tip; three white bands, the first weak. 2. *rubidella* (female) and 4. *pudibundella.*
7. Fore wing with slight traces of pink or none; third joint of palpus with broad blackish base, the first white band of the other species obliterated.....5. *fungivorella.*

1. **A. roseosuffusella** Clemens. Palpus with third segment black, imperfectly banded with white on basal half, the extreme tip white. Fore wing white, lightly dusted with gray, with three blackish bands about as wide as the spaces between them. First band strongly oblique outward, from costa at base, crossing fold, and fading out; second parallel to it, running from costa at a third way out, abruptly truncate in fold; third broader, transverse, at two-thirds way out to apex, with pink spots before and beyond it at inner margin, and containing a large yellow-brown spot or shade. Apical region nearly filled with a black patch, but leaving a white spot at apex. Inner margin shaded with yellow-brown on basal half or more. 10 mm. (*bellella* Walker).

May to October; commonest in July and August. Caterpillar a leaf folder on clover, also feeding on the flowers; also reported from sumach by Clemens, most likely in error.

Generally distributed and common. New York: Ithaca.

2. **A. rubidella** Clemens. Fore wing pink, dusted with fuscous, and somewhat shaded with yellow; head yellowish; palpus with third segment relatively short, with three white bands, near base, before middle, and before tip, the tip black. Fore wing with oblique fuscous bands, much like those of *A. roseosuffusella*, the first one ending at fold, the third dark fuscous toward the costa, shading into brownish yellow below and fading out on inner margin. Apex wholly shaded with blackish, leaving no apical spot. Inner margin broadly shaded with brownish yellow to the middle, interrupted with pink at a quarter way out. Thorax fuscous. Hind wing of male with a hair-pencil. 8 mm.

General in distribution; May.

A. rubensella Chambers, generally considered a synonym, was described as having the palpus white-tipped (perhaps damaged), the underlying ground color white instead of pink, tongue brownish (usually gray in this group), bands of fore wing brown, and thorax pale ochreous. 8 mm. Kentucky.

3. **A. molestella** Zeller. Palpus with third segment as in *pudibundella*. Ground of fore wing powdery gray, the paler scales white-tipped. Half of surface covered by fasciæ, which are even, chocolate brown; first fascia paling out to base, with a couple of yellow dots; second broad, with a yellow spot in it below fold; third parallel, nearly interrupted by a yellow spot over cell; two dark brown dots on costa near apex; costal and dorsal fringe barred with pink in the base, the bars invading the membrane, at least on the costa. First discal dot large, tangent to second fascia; second obsolete; postmedial fascia followed by a black bar in discal fold. 12 mm.

District of Columbia in September; Texas.

4. **A. pudibundella** Zeller. Hardly distinguishable from *rubidella* and the several undescribed species closely related to it. Palpi pinkish white, with black bands

before middle and before apex of third segment. Antennæ blackish, obscurely annulate. Head and thorax variable, usually gray, with pale face; fore wing with ground powdery brown-gray, suffused with yellow and shaded with pink; markings blackish, about as in *D. roseosuffusella,* not distinct below fold, and with a somewhat less distinct costal spot before the apex. Fore wing dark gray beneath, with a longitudinal pale streak along middle of costa, and pale subterminal spot. Hind wing with a streak of rough gray scales below costa. 11 mm.

July.

Massachusetts; Texas. New York: Rock City.

There are a number of undetermined species closely related to this, and which will run to this in the key, but which differ in details of markings and sex-scaling; one, usually considered the same, seems to differ only in the white-annulate antennæ, and eats apple. *A. intermediella* Chambers is a name belonging to a member of this group.

5. **A. fungivorella** Clemens. General pattern as in *roseosuffusella;* etc. Head whitish, tinged with fuscous; palpi white, second segment with three blackish rings, third also with three, leaving the extreme tip white. Fore wing pale luteous, the inner margin strongly dusted with testaceous brown from base to tip; the costal half with bands of fuscous brown, on a brownish-dusted, luteous base; second band ending in a point, opposite which is a blackish, white-ringed dot; a couple of black terminal dots near anal angle. Fringe testaceous with a white patch below apex crossed by a dark line, and a white patch near anal angle. 12 mm.

August. A leaf-roller on willow, often feeding in the various willow-galls.

District of Columbia; Illinois; and probably generally distributed.

6. **A. salicifungiella** Clemens. Very similar to *A. fungivorella,* of which it is possibly a red variety. Head reddish, palpi pale red with two black rings on second segment; third segment black-tipped; fore wings dark brick red, the outer half almost solid red, the basal half marked with whitish; a whitish band near the base, dusted with fuscous, and followed by a darker, red-brown band; three small white spots on costa; ground dusted with fuscous, and inner margin with whitish red and fuscous. Fringe red. 13 mm.

August. Caterpillar in a loose open web between leaves of willow, not drawing them together; eating parts of the leaves. Pale green, with many fine broken lines; head paler, straw yellow. July. Cocoon outside the web, in trash, etc.

Illinois; Texas, in June.

A. ivæ Busck, a Florida species without any pink shading at all, is to be expected northward where its food, *Iva frutescens,* occurs.

7. **A. elegantella** Chambers. White. Four transverse, black-edged, rich brown bands; a black bar on middle of disc containing four or five metallic lead-blue spots. 13 mm.

June, in Texas.

Texas to Missouri, central Illinois, and west, doubtfully reported from Pennsylvania.

8. **A. absconditella** Walker. Shining bronzy gray-brown; extreme tip of second segment of palpus white; third segment white with blackish shading at base and apex; fore wing with a black spot at end of cell and sometimes a less distinct one at middle; a fine outwardly oblique subterminal line from costa, fading out at middle of wing, and a similar line opposite it running from inner margin, the two at right angles. Fringe with more or less distinct, blackish basal line, cut with luteous. 8–10 mm.

May and June. Larva in stem of Polygonum, often causing a slight gall; and apparently the same species in Ampelopsis. Larva hibernating.

District of Columbia; Kentucky; Missouri.

9. **A. minimella** Chambers. Dark fuscous, indistinctly sprinkled with white, no annuli on antenna; face a little paler below; fore wing with obscure pale postmedial dots on both margins. 9 mm.

July and August. Caterpillar on oak.
New Jersey; District of Columbia to Kansas and Texas.
There is a closely related species on Polygonum associated with *A. absconditella.*
10. **A. physaliella** Chambers. Practically identical with *A. minimella,* but with he pale lower part of the face sharply defined, and contrastingly pale. 9 mm.
May; July. Caterpillar a leaf-miner on under side of leaves of Physalis. Green ith yellow head and cervical shield; at maturity becoming crimson with greenish ead and cervical shield; cocoon outside the mine. The moth of the second brood merging the next spring.
Kentucky; Texas.
11. **A. disconotella** Chambers. Light dull ochreous, somewhat dusted with gray. 'alpus brown, apex of second segment pale, third with a broad blackish band t middle, at least in outer side. Fore wing with a horizontal elliptical black pot at end of cell, and a smaller spot below costa half way to base. 8 mm.
June. Larva in stem of raspberry.
District of Columbia; Kentucky; Mississippi.
12. **A. gilvolineella** Clemens. Superficially very close to *Paltodora striatella,* ut with simple palpi. Palpus with second segment dark on basal half and white n outer half within, mostly black outwardly. Fore wing pale yellowish, overaid with fuscous brown, the outer part rather darkened. Apex crossed by a fine ale line running to a pale shade on outer margin. Discal dot black, distinct; ringe with a black basal line, cut by the pale terminal bars. Antennæ dark. There may be a black claviform spot also. 12 mm.
July.
Pennsylvania: Philadelphia, Hazelton, Easton.
13. **A. angustipennella** Clemens. Similar to *A. gilvolineella,* head and thorax nd base of fore wing nearly white; outer part light brown. Antennæ white on basal wo-thirds, fuscous-barred at tip; palpus white, with a black bar on second segment nd apical half of third segment black, except extreme tip. Fore wing with some longitudinal brown streaks near base, dot at end of cell smaller than in the preceding species, and claviform dot obsolete; postmedial line shorter and without a pale spot at its apex. 12 mm. (*kearfottella* Busck.)
July.
New Jersey to Ohio.
14. **A. quinquepunctella** Busck. Antennæ light fuscous, annulate with luteous. Palpi with second segment fuscous with white apex, third white with fuscous apex. Face whitish, head and thorax dull luteous; fore wing luteous, with grayish dusting, becoming fuscous outwardly, with five black spots on disc, four in a rhomb (the basal sometimes weak) and one beyond. Hind wing paler. 12 mm.
June.
Pennsylvania.
An apparently identical species occurs in southern California.
15. **A. robusta** Braun. Dull ochreous, rather densely overlaid with purplish fuscous dusting, especially toward apex of fore wing. Palpus blackish, apical half of third segment, and sometimes extreme apex of second, white, extreme apex of third sometimes black. Base of antenna fuscous, annulate with white, apex blackish, with apical segment, and fifth and tenth segments from apex, white. Fore wing with a pale costo-apical streak, an elongate black discal dot and faint dark shades; fringe with a broken line in base. 11–12 mm.
Larva at first forming a small, transparent blotch mine in *Scirpus atrovirens;* then a linear green mine, and finally a broader transparent portion. Larva in the spring; moth in June.
Cincinnati, Ohio.

22. *ENCHRYSA* Zeller

Similar to Aristotelia, but with the outer half of the costa distinctly concav Palpi entirely smooth, as long as head and thorax, and strongly divergent.

1. **E. dissectella** Zeller. Dark bronzy brown, nearly black. Basal half of fo wing brown with decided green iridescence, the brown area ending in a vertic yellow line. Outer half orange, with a large blackish patch, starting just beyo middle of costa over half as wide as the wing, and gradually tapering to ape Fringes blackish. Apical fourth of antenna white. 11 mm. (*Aristotelia youngel* Kearfott).

July. Rare.

Ontario to Ohio, west to Vancouver Island. New York: Wells (New York Sta Museum).

23. *CHRYSOPORA* Clemens

(*Aristotelia,* in part; *Nannodia* Heinemann; *Nomia* Clemens, nc Latreille)

Very close to Aristotelia. Palpus hardly longer than head, with third segmer much shorter than second. Fore wing as in Aristotelia; hind wing narrow (fi 168) with apex strongly produced, and M_1 rudimentary.

1. **C. lingulacella** Clemens. Golden yellow; head and thorax blackish, iridescen palpi paler with fuscous third segment; antennæ dark. A blackish, more less metallic, patch on base of costa; an elongate one on basal half of inn margin, and a large trapezodial patch on middle of costa, all edged with brillia violet-silver. Costa edge brown outwardly. Fringe dark brown, with silver in i base below apex. Hind wing dark. 7 mm. (*hermanella* Chambers, *armeniel* Frey and Boll).

May; August. Caterpillar in September, in a large blotch-mine on Chenopodiu and Atriplex.

Pennsylvania and Kentucky to Michigan and Kansas.

2. **C. hermanella** Fabricius. Very similar, but with the silvery antemedial ban extending clear across the wing, and the ground deeper orange. Caterpillar lik *lingulacella.*

Ontario; Minnesota; Iowa; Missouri; possibly introduced from Europe. Ne York: Ithaca.

24. *RECURVARIA* Haworth

(Restricted, not Meyrick. *Evagora* Clemens; *Eidothoa, Sinoë* Cham bers; *Aphanaula* Meyrick)

Palpi slightly roughened beneath, third segment nearly as long as second. Fo wing (fig. 167) with M_1 stalked with R_5 nearly to apex, Cu_1 longer than Cu_2 an much more closely approximated to M_3; usually with raised scale-tufts. Hin wing typically nearly trapezoidal, male often with costal hair-pencil. R and M only moderately approximate at base.

The caterpillars of one group are miners in the needles of various conifers. I the needle-conifers they pass from needle to needle in a thin silken tube along th stem; in the scale-type they eat out the spray as a whole. The moths emerge i June. The young larvæ hatch in July and form a minute mine in a single needl in which they hibernate, in the spring moving to a new place and feeding u rapidly. The deciduous feeders live in a silken tube on the suface of the lea and seem to have the same seasonal history. The species are close and not full understood; many can hardly be determined without the food plant.

Key to the species

1. Fore wing with a longitudinal stripe through the middle from costa near base to apex.
2. Costa clay-color, contrasting; larva on juniper.....6. *juniperella.*
2. Costal area about half covered with black mottling; on sweet gum. 12. *dorsivittella.*
2. Costa very dark, concolorous with median area, the black streak lying in the fold; on alder.....15. *alnifructella.*
1. Fore wing without longitudinal stripe, or (*obliquistrigella*) with a slight one on the apical half only.
2. Blackish and black with a little white scaling and an angulate, white postmedial band.
3. Head and inner margin dark-dusted and shaded on a luteous ground. 5. *piceaella*, variety *obscurella.*
3. Head and inner margin blackish, concolorous.....14. *nigra.*
2. Not dominantly brownish black.
3. Third joint of palpus white, immaculate.....2. *variella.*
3. Third joint of palpus with two black spots, at least.
4. Fore wing more or less yellowish.
5. An oblique antemedial fascia running from costa to fold.
6. Ground decidedly tinted with yellow; head straw yellow. Larva on spruce.
7. Fasciæ broken, leaving the series of tufts in the cell showing as black dots about as conspicuous as those in the fold. 3. *coniferella.*
7. Ground duller; fasciæ covering the series of tufts in the cell. 4. *piceaella.*
6. Ground hardly tinted with yellow; head cream color.
7. Fasciæ separate; on arbor vitæ.....5. *thujaëlla.*
7. Second fascia running out in cell to join third; on juniper. 7. *gibsonella.*
5. A slight yellowish-white antemedial shade only; cell-tufts minute or absent; second segment of palpus yellowish white. 1. *apicitripunctella.*
4. Fore wing not tinted with yellowish.
5. Fore wing with a strong, oblique, white streak at a third way out. 13. *cristatella.*
5. No strong white costal streak one-third way out.
6. A black dorsal patch near base.....10. *robiniella.*
6. No such patch.
7. Male with hair-pencil toward inner margin; palpus with second segment mostly blackish; first antemedial fascia short; larva on oak .....11. *quercivorella.*
7. Hair-pencil not reported; palpus with second segment heavily dusted with gray; first fascia reaching to fold.
8. Ground brown, suffused on a cream-colored base; larva on arbor vitæ .....5. *thujaëlla.*
8. Blackish on cream; on juniper.....7. *gibsonella.*
7. No hair pencil; palpus with two black bars on second segment; larva on thorn.....9. *cratægella.*

I. *Evergreen feeders, ground strongly yellowish.*

1. **R. apicitripunctella** Clemens. Pale yellow, shading into white; palpus with second segment banded with yellow and white, third white with two black bars. Antennæ annulate, pale yellow and blackish. Fore wing with a brown shade on base

of costa, some black scales before middle, and a slight oblique postmedial fascia fro costa, of darker yellow, scaled with black, and edged with white. A black tu in fold opposite this fascia. About five small black terminal dots, the apical larges Sometimes with a complete angulate white postmedial line. Male with hair penci 9 mm. (*abietisella* Packard).

June and July. Caterpillar webbing needles of hemlock in early June. Gree with blackish head and cervical shield.

New Jersey to District of Columbia and Pennsylvania; probably more general distributed. New York: Wells.

2. **R. variella** Chambers. Yellowish white, apical half of fore wings suffused wit golden yellow or dusted with brown; three or four distinct black dots at base costal fringe, which has some scattered black scales; occasionally with a coup of fine streaks along costa. Costa sometimes wholly brown or golden. Sometim with a white angulated postmedial fascia broken at middle; a raised black tu on fold at three-fourths way to apex. Head, including inner side of palpi an antennæ, white. Outer side of palpi yellow. 8 mm.

June and July. Caterpillar in a silk-lined tube between needles of bald cypre and evidently other trees. Mississippi valley specimens are yellower than easter ones.

Montclair, New Jersey and District of Columbia to Kentucky. New York Yonkers.

3. **R. coniferella** Kearfott. Similar to *R. apicitripunctella;* ground ochre, not lemo yellow, and much mottled with white; antemedial fascia nearly continuous as fa as fold, but all fasciæ showing the tufts as partly or entirely separated dots. Ape and fringe more heavily gray-dusted; second segment of palpus rather heavily scale with black, suggesting two fasciæ.

June. Larva on pine.

Ottawa; Ontario.

4. **R. piceaella** Kearfott. Similar to *R. apicitripunctella*; dark, dusted wit fuscous on a straw-yellow ground; head straw yellow, concolorous with the groun Fore wing with three fasciæ, like *R. thujaëlla*, the outer one white, and right-angle at the middle; normally a black dash in the terminal area, extending to the ape Hind wing dark gray. Abdomen with dark dorsal patches. 10 mm.

Variety **obscurella** Kearfott (*nigra* Kearfott, not Busck), is suffused with blackis except on the inner margin, and on the costa beyond the median fascia, where i is powdery luteous; white postmedial fascia only, contrasting. Head luteous; th face lightly and vertex heavily dusted with black.

Caterpillar webbing and mining needles of red and black spruce. Red, wit light brown head and cervical shield and dark green dorsal segmental patche Crimson ventral spots on thorax between legs, and on fifth and sixth segment of abdomen. Moth in June.

New Jersey. Apparently the same moth occurs in Ontario.

5. **R. thujaëlla** Kearfott. Palpus with first segment black, second with a blac streak below and dusted with black, third white with two black bars. Head cream white, paler than in *R. piceaëlla*. Fore wing cream-white, heavily dusted wit blackish, appearing fuscous gray; with three oblique blackish fasciæ, the firs reaching to fold, the other two shorter; apical region darker, with blackish streak running out to the strong costal terminal dots. Tufts well marked, in three pairs black. Hind wing light gray. Abdomen cream-white. 9 mm.

June. Caterpillar on Thuja, eating out the sprays from inside, in May. Head cervical shield, true legs, and anal plate black-brown; body dull red with greenis incisures, pinkish below.

New Jersey and probably rather generally distributed. New York: Westbury Long Island.

6. **R. juniperella** Kearfott. Palpi with black on outer side; antennæ annulate scape white in front. Fore wing powdery gray, with a curved black band fron

base of costa to costa near apex, defined above except at the tip with a white streak; and containing three raised tufts. Costal area heavily mottled with blackish, forming three oblique fasciæ, the outer sometimes meeting the longitudinal streak. Dorsal region lighter gray, with three raised black tufts and three minute ones along outer margin. 10 mm. (*obliquestrigella* Chambers?).

June; August. Caterpillar on red cedar and ground pine (Juniperus), in a web or eating out the sprays; pale green with light brown head, cervical shield, and true legs; segments dorsally with pinkish open rectangles, filled with the ground color.

Connecticut; New Jersey.

7. **R. gibsonella** Kearfott. Similar to *R. thujaëlla.* Ground yellowish white, heavily overshaded with black; the first fascia reaching to fold or beyond, second broadening at middle of wing and sending out a long spur to meet the third, which is angulate and reaches inner margin. Head whitish; palpus with two bands on third segment, sometimes fused into a broad area, leaving only the base and tip white; always rather dark. 11 mm.

June. Larva on juniper in May. Head and cervical shield pale honey yellow.

Ottawa; Quebec.

(Number 8 is vacant.)

II. *Larvæ deciduous feeders. Moths without yellow tint. Palpus with third segment more slender than in group I, twice as long as eye, more than half of its surface covered with two broad black fasciæ, second segment mostly brown. Face and scape white. No hair-pencil.*

9. **R. cratægella** Busck. No hair pencil. Wings shorter than usual; white, dusted with black. Antennæ annulate; palpi white, with two black bars on each segment and white tip. Head powdery gray. Fore wing with two oblique dark streaks from costa, the first reaching inner margin, but sometimes broken; the second reaching to cell only; and a third angled on outer side and running to below tip of second, in fold, followed by a white line; a broad blackish shade running from its angle to the apex. Basal half of fringe powdered, outer half pale, with a gray line. 12 mm.

May to July. Larva on Cratægus. Probably a race of *R. nanella* of Europe.

New Hampshire to District of Columbia and Ohio. New York: East Aurora, Batavia, Albany.

10. **R. robiniella** Fitch. Powdery fuscous gray, somewhat mottled, with only the angulate and incomplete postmedial line pure white. Palpi with outer side of second segment fuscous, except at tip, inner side with two bands indicated; third segment with two black annuli. Fore wing with a blackish bar extending up and out from basal angle; a small blackish costal spot before middle, and a larger one before the postmedial band; a raised black dot beyond middle of cell; another in fold at three-fourths way to apex. Head pale. 7 mm. (*robiniella* Fitch, imago, not larva; *fuscopallidella, robiniæfoliella* Chambers).

Caterpillar pale greenish; between two leaflets of locust.

Eastern United States south to Texas and north to District of Columbia.

11. **R. quercivorella** Chambers. Very irregularly dusted and mottled with black on white, leaving most of the white along costa and inner margin, and forming a more or less distinct, but quite irregular, longitudinal median fascia, at least toward base. Head powdery gray; male with a large, spreading, yellow pencil at anal angle. 11 mm. (*gilviscopella* Zeller.)

Larva on oak, in a silken tube on the under side of a leaf; white with red spots. Moth in June.

12. **R. dorsivittella** Zeller. Palpi annulate, tip white; face white; vertex darker, powdery; thorax and fore wing powdery dark brown and white, the dark predominant; inner margin pale, a whitish streak near base of costa, a white spot

on costa beyond middle, white along costa outwardly and at apex, with a brow costo-apical spot. Fringe pale. 12 mm. (*vagatioella* Chambers.)

May. Caterpillar in a brownish frass-tube 1 mm. in diameter and 1 centimete long, along a vein on under side of leaf of sweet gum, skeletonizing leaf about th ends of the tube. Tube with somewhat valvular openings at the ends, which ar closed before pupation. September.

13. **R. cristatella** Chambers. Rather heavily powdered with black and white more evenly than usual, leaving a broad, oblique, clear white, antemedial fascia from costa to fold, where it fills the space between the first two tufts; a blackish shade before it; three black tufts in fold; postmedial line pale, distinct, angulate 7 mm.

Kentucky. Type only known.

14. **R. nigra** Busck. Black with a silvery glance; darker than *obscurella*; hea dark, antennæ obscurely annulate. Fore wing with traces of the silvery-whit ground color, and a V-shaped fascia at three-fourths way to apex, its two limb paralleled by a fine line beyond. Tufts black. Hind wings blackish. Legs witl white annulations and tufts. 11 mm.

May. Larva on Hypericum.

15. **R. alnifructella** Busck. Purple-black; the first two fasciæ from costa absent or represented by a few white scales; inner margin below fold nearly white, con trasting; the outer margin as far as the apex also strongly mottled with white Fold defined with black; the usual tufts black and white, the outer one showing as a distinct pale spot. Postmedial line whitish, irregular and broken, the upper half in part parallel to costa and outlining a pale patch, the lower half often lost Head and thorax contrasting, nearly white. 10 mm.

Caterpillar in catkins of alder in late fall, emerging in the spring. Pale; hea brownish yellow; cervical shield and anal plate dark brown; each segment witl a transverse pink band on dorsum and mottling below; abdomen with pink incisures

25. *EUCORDYLEA* Dietz

Palpi with a dense expansible tuft on upper side of second segment; third shorter Fore wings slightly concave at Cu_2, sinuate, apex rather obtuse, with all veins preserved. M_1 stalked beyond origin of R_1; M_2, M_3, and Cu_1 approximate, Cu_4 distant, running to concavity of inner margin. Hind wings about as wide as fore wings, trapezoidal, with all veins preserved. R and M_1 connate, M_2 and M_3 approximate, M_3 and Cu_1 nearly connate. A slight modification of Recurvaria.

1. **E. atrupictella** Dietz. Pale creamy yellow, palpi with dark base and two bands each on second and third segments (as often in Recurvaria). Antennæ annulate. Fore wing blackish-marked, an oblique band one-fourth way out, shaded inwardly; a heavy oblique band from middle of costa about to fold; and a thinner erect one beyond, connected to it by a bar on disc. A series of small black dots around apex. Hind wings cinereous. 12 mm.

August.

Hazelton, Pennsylvania; Ontario. New York: Ithaca.

26. *EPITHECTIS* Meyrick

(*Taygete* Chambers; *Parasia*, in part)

Similar to Recurvaria. Fore wing (fig. 169) with Cu_2 as long as Cu_1 and nearly parallel to it; M_3, Cu_1, and Cu_2 evenly spaced at origin. Hind wing with R and M_1 stalked, R running to costa before apex, M_1 usually to outer margin, rarely also running to costa; M_3 and Cu_1 connate or short-stalked.

Key to the species

1. A black terminal spot just below apex, as in Duvita.....2. *subsimella.*
1. No single black terminal spot.
2. Fore wing overlaid with dark scales.
3. A broken, oblique antemedial band, farther out on costa.
4. Band broken into contrasting spots; ground practically white. 3. *saundersella.*
4. Band heavy; ground fuscous.....5. *syvicolella.*
3. Smaller; bands oblique out to inner margin; browner, with dark apex. 3. *saundersella.*
2. Fore wing whitish gray, with contrasting blackish spots.....1. *attributella.*

1. **E. attributella** Walker. Hind wing with M_1 running to apex, M_2 almost connate with M_3 and Cu_1, which are long-stalked; cell open. Powdery pearl white (each scale fuscous and white). Palpi fuscous, tip of second joint and two bands on third white; antennæ dark. Fore wing with a large costal spot at base and one rather beyond middle, a small one between them, and two or three less intense ones on inner margin. Raised dark dots at end of cell and in fold. Apex lightly spotted with fuscous. 10 mm. (*difficilisella* Chambers.)

The moth is locally common, resting on the trunks of trees in July.

Massachusetts to North Carolina and Illinois. New York: Ithaca.

2. **E. subsimella** Clemens. R and M_1 normal. Head and thorax yellowish fuscous; palpus with second joint brownish with a white ring at tip, third joint white with outer half black; antennæ dark, scape striped with yellowish in front. Fore wing dark yellowish fuscous, brown along costa from the middle and toward the tip; ground much sprinkled with white outwardly, a short yellowish white streak at middle of costa and an angulate line at two-thirds way out; a blackish spot below apex; and a dark streak in fringe. 8 mm.

A southern species, doubtful in our territory.

3. **E. saundersella** Chambers. Pale creamy yellow. Palpi with the two terminal joints brown with white tips, and a band on the third. Head and thorax dusted with blackish. Fore wing densely dusted below the fold, with three blackish costal spots and two on disc, sometimes partly confluent into two oblique bands. Apex heavily suffused; a dark line in base of fringe. Hind wing pale slate color. 7 mm.

Kentucky. Types only known.

4. **E. geminella** Riley. Cream white; a basal, blackish fascia of two partly fused spots, and antemedial and postmedial fasciæ of about three spots each; all three parallel, and farthest out at costa. Fringe with a series of dark bars in base, and preceded by a fuscous terminal spot.

Larva on oak.

Only a single specimen seen, in National Museum, and marked "*rileyella* type." This is possibly the same as *E. gallægenitella* Clemens, of which I have not studied any authentic material.

5. **E. sylvicolella** Busck. Fore wing dirty white, thickly dusted and shaded with fuscous, and marked with black. No terminal dots. A raised, oblique, dark streak near base, farther out on costa, and broken into spots on costa, fold, and inner margin, sometimes obscure; another on costa two-thirds way out, defined outwardly by an outwardly oblique white line; and three bars along cell, sometimes running together into a line or obscure. 9 mm.

New York (Busck); Kentucky; Texas.

27. *TRYPANISMA* Clemens

Body and hind wing similar to Recurvaria. Fore wing with M_2 closer to M M_3 and Cu_1 stalked. Hind wing with R and M_1 stalked, R running to apex.

Key to the species

Head white ..... 2. *fagell*
Head suffused with fuscous ..... 1. *pruden*

1. **T. prudens** Clemens. Head pale yellowish white; vertex with large, blackis spots on most of the scales; second segment of palpus with two dark brown spot on the outer side, or wholly dark, and third segment with rings. Antenn slightly annulate. Thorax and fore wings powdery blackish, tinted with yellowisl darker than *T. fagella*, with a small ochreous dot below base of costa; a patc on middle of disc, often reaching inner margin, preceded by black dots in the cel and a postmedial band, strongly angulated or broken into costal and dorsal bar as in *T. fagella*. Hind wing fuscous. 9 mm. (*quinqueannulella* Chambers.)

May. The caterpillar forms a web on the under side of an oak leaf near th tip, communicating by holes with the upper side where the caterpillar feeds.] occurs in July and August. The pupa is formed in a slight cocoon in the leaf.

District of Columbia; Pennsylvania; Ohio.

2. **T. fagella** Busck. Head white. Antennæ annulate with fuscous. Palpi wit only one faint annulation on second segment, and two on third. Thorax and for wing powdery light gray. Two circular blackish spots (at middle and end of cell in a cream-yellow shade, which reaches the inner margin at the middle; a large diffuse oblique streak at base of costal fringe and a spot on the inner margi opposite it, both edged beyond with cream. Hind wing, with fringe, and abdome light silvery gray. 9 mm.

Caterpillar similar to *T. prudens*; on beech.

District of Columbia.

28. *EVIPPE* Chambers

(*Phaëtusa* Chambers)

Similar to Epithectis and Recurvaria. Fore wing with all veins present; M and M_3 connate or more often stalked; Cu_1 free, halfway between M_3 and Cu_2, an equally long. Hind wing (fig. 162) nearly as wide as fore wing, with slightl produced apex, R sinuous and running to apex, M_1 lost, cell very weakly closed o open, M_2 close to M_3, which is almost connate with Cu_1.

The moths are superficially similar to *Recurvaria dorsivittella*, but have cleaner cut markings and lack the two black palpal bands of Recurvaria.

1. **E. prunifoliella** Chambers. Palpi white, with base of second joint and extrem tip of third blackish. Head and thorax white, with a blackish shade above antennæ and black tegulæ. Fore wing black, shading into dark gray on costa, powdery toward apex along outer margin. Inner margin broadly white, with a twice-wave upper boundary, which becomes diffuse at apex. A subterminal costal spot, mor or less distinct. 9 mm.

May to June. Caterpillar under the folded tip of a leaf of plum or peach i late fall; apparently a leaf-miner when young; rarely on soft maple.

E. leuconota Zeller, a much smaller species, without any trace of the costal pal spot, has been reported from Albany, New York.

29. *SITOTROGA* Heinemann

Antenna with a sparse pecten, otherwise practically like Metzneria. We have only one, probably introduced, species, of Oriental affinity; the Angoumois grain moth.

1. **S. cerealella** Olivier. Fore wing silky luteous yellow; hind wing fuscous, fringes brownish fuscous. Ordinarily without markings, though some moths show a black discal dot and a streak in the fold, and some, streaky black scaling. 15 mm. (*Anacampsis; Gelechia*).

Caterpillar stout, legless, white, with yellow head, breeding continuously in stored grain. The moth flying at large in August.

New York: Geneva, Ithaca, Albany; Smithtown, Long Island.

30. *METZNERIA* Zeller

(*Parasia*)

R_4 shortly, and R_5 long-stalked, with M_1 (fig. 170); the other veins separate. Hind wing with all veins widely separate, **R** and M_1 somewhat divergent, M_1 and M_2 twice as far apart as the others; anal region much reduced.

This is a European genus of some size. We have one species probably introduced with its food plant.

1. **M. lappella** Linnæus. Fore wing dull olive brown with paler yellowish shades and streaks. Hind wing dark fuscous gray. 12–15 mm.

May to August. Caterpillar stout, white, with black head and divided brown cervical shield; legless; in burs of burdock, eating out the seeds and wintering as larva.

Europe; Canada to Pennsylvania. New York: Peru, Newcomb, Lewiston, Ithaca, Katonah.

31. *PTYCERATA* Ely

(*Pyncostola* Meyrick (?); *Paltodora* Meyrick, in part, not typical; *Cleodora* Curtis, not Peron and Lesueur, etc.)

Palpus typically with a long triangular terminal scale-tuft on second segment; in subgenus **Isophrictis** Meyrick with a looser brush of spreading hair, very loose in *anteliella* and *busckiella*. Hind wing with **R** and M_1 approximate or connate; otherwise like Metzneria.

Key to the species

1. A white oblique costal streak running down from beginning of costal fringe.
   2. Head cream white ..... 1. *striatella.*
   2. Head and thorax brown ..... 2. *anteliella.*
1. No such streak.
   2. Entire wing with white-tipped scales and longitudinal ochreous streaks. 3. *similiella.*
   2. Whitish, with two or three blackish dots ..... 4. *busckiella.*

1. **P. striatella** Hübner. Brown; a fine white streak extending obliquely across apex, with two white costal dots beyond it; an oblique whitish streak at anal angle, and more or less distinct pale longitudinal streaks. Fringe with a black bar across apex. Hind wing fuscous. Head, including palpi and more or less of thorax, contrasting, whitish. 12 mm.

September. Very likely this species is rather generally distributed with its food, tansy, but I find no authentic records.

Europe.

2. **P. anteliella** Busck. Head and thorax pale fawn color; concolorous. Fore wing darker reddish brown, two black streaks toward base, and a black discal dot; a fine white line across apex and a white bar in fringe at apex.

When fresh, this species shows the triangular palpal tuft, but it is easily lost. 12 mm.

New Jersey; western Pennsylvania.

3. **P. similiella** Chambers. R and M_1 of hind wing shortly stalked; palpus rough. Fore wing with the yellow streaks irregular and anastomosing, leaving a powdery band around the apex. Superficially, practically like the species of Phthorimœa, but distinguishable by the venation and the more bushy palpus. (*Isophrictis* Braun; *solaniella* Chambers, in part, not larva; *piscipellis* Zeller.)

The larva breeds in heads of *Rudbeckia hirta;* pupating in the stem. Moth, June to August.

Kentucky; Ohio; Texas; Oklahoma.

4. **P. busckiella** Ely. Palpus with a triangular tuft; M_3 of hind wing lower than in the other species, arising from middle of end of cell. Antenna yellowish; palpus with second joint brown, third white, brown-shaded; head and tegulæ white; thorax darker. Fore wing light clay-color; two or three small, more or less elongate, brown spots; hind wing smoky with paler fringe. 12–15 mm.

June and July. This species looks like a Gelechia, but structurally belongs to this series.

32. *AGNIPPE* Chambers

Palpi with second segment rough-scaled, third about as long. Fore wings with 10 or 11 veins, R_1 absent, M_1 long-stalked with M_3, or absent, Cu_2 long. Hind wing slightly broader, trapezoidal, pointed at apex, M_1 absent, cell open, M_3 to Cu_2 evenly spaced. Fore wing with a tuft of raised scales in middle of fold. Moth resting with tail raised, like many other Gelechiids. A reduction-form of Recurvaria.

Key to the species

Head dusted with black; M_2 present.....1. *biscolorella.*
Head all white; M_2 lost.....2. *fuscopulvella.*

1. **A. biscolorella** Chambers. Antennæ annulate. Head yellowish white. Vertex dusted with brown at sides. Palpi mostly blackish, annulate. Thorax and base of fore wings yellowish, with a blackish brown patch on front of thorax. Fore wing blackish fuscous with bluish iridescence, middle to apex heavily dusted with brown and some white. Tuft small, black and white. 12 mm.

May. Larva possibly on Gleditschia.

Southern Ohio and Kentucky.

2. **A. fuscopulvella** Chambers. Head white. Palpi yellowish fuscous at base and near tip. Antennæ annulate. Thorax and wings whitish yellow, densely dusted with fuscous, duller than in the other species, leaving the black tuft contrasting. 11 mm.

April. Rare, only one specimen seen.

Kentucky.

33. *STEREOMITA* Braun

Similar to Metzneria. Palpus with second segment thickened and slightly tufted beneath; third equally long. Fore wing with one dorsal vein lost (M_2 or

Cu_1 ?); the remaining cubital widely separated from the other two, which are connate. Hind wing with R_3 widely separated from stalk of R_4 to M_1; R_1 from beyond middle. Hind wing half as wide, with M_3 and Cu_1 widely separated, M_2 nearest M_1, M_1 connate with R.

1. **S. andropogonis** Braun. Pale ochreous, dusted with dark brown. Head paler; palpus with a brown spot on outer side of second segment, and annulus on middle of third. Fore wing with the dusting denser at apex, gathering in longitudinal streaks, and usually forming two oblique postmedial streaks on costa; costal fringe ochreous, dorsal brownish, with brown terminal dots and a bar at apex. Hind wing pale brown, fringes reddish ochreous. 9 mm.

Larva in inflorescence of *Andropogon scoparius*, showing its presence by a yellowish patch in the flower-spike. Moths in August, flying at dawn and evening, and resting head down.

Clermont County, Ohio.

34. *HELICE* Chambers

(*Theisoa* Chambers; *Cacelice* Busck)

Palpus with third segment very long, much longer than the second, which is nearly smooth, curved, and fusiform. Fore wing lanceolate, with R_3 lost in the male, usually stalked in the female, M_2 lost, M_1 long-stalked, and M_3 and Cu_1 stalked, with more or less distinct gray scale-tufts. Hind wing half as wide or a little more, lanceolate or notched below the apex, always very narrow. Sc two-fifths length of wing, R often lost at base or entirely lost, and M_1 running to just below the apex, (male) or with R and M_1 represented by a single free vein running just above the apex (female); M_2 lost; M_3 and Cu_1 stalked (male), or cell open above M_3 (female).

The extraordinary sexual dimorphism in venation has had a curious effect on the synonymy of this genus. It is the most reduced of the recognized Gelechiidæ.

I. *Female with apex of hind wing produced, and outer margin concave below it* (Helice).

1. **H. pallidochrella** Chambers (fig. 173 ♀). Light gray, powdery, a small costal dot near base, a large dark antemedial spot, crossing the cell but not crossing A, a third way out; usually with a smaller costal spot at three-fifths way out, a subterminal shade on costa and a complex of dark streaks across apex of membrane. 9 mm. (*gleditschiœella* Chambers; ♂ *Cacelice permolestella* Busck).

Larva probably on Gleditschia. Moth in May and late summer.

Kentucky; Maryland; southern Ohio.

II. *Female with lanceolate wings as in male* (Theisoa).

2. **H. constrictella** Zeller (fig. 171 ♂, 172 ♀). Light wood-brown, shaft of antenna lighter, annulate with dark brown. Fore wing darker at base, especially before the antemedial line, which is excurved evenly, except for a sharp inward turn in at costa, and followed by a paler shade. Sometimes with a black discal dot; a blackish costal spot at two-thirds way to apex, followed by a pale one, the boundary sharp and oblique, sometimes extending into a short fascia. Dorsal fringe paler. 8 mm. (*bifaciella* Chambers).

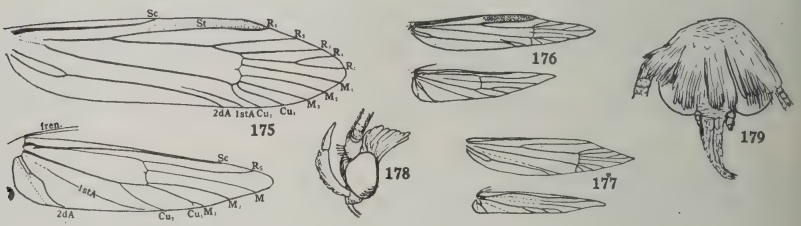
May to July. Larva on elm, forming a web on the under side of the leaf, connected by a whitish tube of silk and frass to the base of the petiole; spinning a thin, oval, silken cocoon. July and September.

Massachusetts to southern Ohio and Texas.

Family 22. **BLASTOBASIDÆ**

(*Gelechiidæ*, in part)

Head smoothly scaled, with the scales long and curving down over face, often diverging and covering the face and the base of the antennæ with a fanlike tuft (fig. 179). Antennæ long, scape broad, with a heavy pecten more or less mixed with scales (fig. 178) sometimes forming a definite eye-cap (Calosima). Shaft with two bands of scales to each segment, one more broadly interrupted below than the other; sensory hairs strong, especially in males. Many of the Blastobasinæ have the shaft notched at the base in the male. Palpi typically smoothly scaled and upturned beyond the vertex (fig. 178); reduced in the Pigritiinæ (fig. 179), never reaching beyond the middle of the front, but smoothly scaled or nearly so; in the latter often modified, with a specialized sensory area in the male. Tongue strong, scaled at base. Fore wing with $\mathbf{R}_1$ arising well toward base of wing, $\mathbf{R}_2$ near apex of cell, usually more than nine-tenths way out on the cell and much shorter than $\mathbf{R}_1$; $\mathbf{R}_3$ arising from upper angle of cell; $\mathbf{R}_4$ and $\mathbf{R}_5$ long-stalked, usually arising from end of cell, and well separated from $\mathbf{R}_3$, $\mathbf{M}_1$ free, $\mathbf{M}_2$ to $\mathbf{Cu}_2$ arising in a group from lower angle of cell, $\mathbf{Cu}_2$ starting off at



FIGS. 175–179. BLASTOBASIDÆ

175, *Holcocera purpurocomella* (?), venation; **176,** *Blastobasis phycidella* (Europe), venation; **177,** *Pigritia* species, venation; **178,** side view of head of Blastobasinæ; **179,** front view of head of Pigritia, showing minute palpi and imperfect eye-cap.

right angles, and usually running straight across to inner margin, perpendicular to $\mathbf{M}_2$; $\mathbf{M}_3$ and $\mathbf{Cu}_1$ intermediate in direction. $\mathbf{M}_2$ and $\mathbf{M}_3$ often stalked; **1st A** developed at margin, sometimes arising from **2d A** near its tip; **2d A** normal and forked at the base also. Fore wing with a thickened stigma between $\mathbf{R}_1$ and costa. Hind wing narrower than fore wing, **Sc** and **R** normally fused for a short distance at base; **R** and $\mathbf{M}_1$ well separated, parallel; $\mathbf{M}_2$ closely associated with **Cu**-stem; $\mathbf{M}_3$ often stalked with $\mathbf{M}_2$ or $\mathbf{Cu}_1$ or lost; $\mathbf{Cu}_2$ normal, much farther from end of cell than in fore wing. Anal

egion reduced, with more or less traceable veins. Fringe two-thirds o one and a half times as wide as membrane. Hind tibiæ with long air; tarsi normal, with weak spinules. Female ovipositor slender, sually exserted.

Larvæ known only in the Blastobasinæ; prolegs short, with a complete series of uniordinal hooks; otherwise like the Œcophoridæ, and not distinguished in any way from those of Endrosis; tubercles **i** and **ii** distant, **iii** of eighth segment of abdomen above and behind spiracle; ocelli reduced. Pupa of Gelechioid type; not studied.

A small family, derived from the scavenger group of the Œcophoridæ, from which they differ only in the fusion of **Sc** and **R** of the hind wing, the rather heavier pecten, the closer grouping of the veins at the end of the cell of the fore wing, and the stigma. Endrosis is sometimes also included here, but is Œcophorid in the characters named.

The species are all obscure and very imperfectly known; the few known larvæ are borers in nuts (often scavengers after other borers), scavengers, and predaceous on scale-insects.

Key to the genera

1. Palpus not reaching beyond middle of front, often rudimentary; hind wing with 7 veins, M_3 completely fused with Cu_1 (**Pigritiinæ**).
2. Fore wing with R_3 stalked with R_{4+5} ..... 9. *Pseudopigritia.*
2. Fore wing with R_3 free.
3. Fore wing with M_2 and M_3 stalked (fig. 177).
4. Palpi minute in both sexes ..... 7. *Pigritia.*
4. Palpi in male upturned to middle of front with a linear sensory area, concealed in a groove in the front in life ..... 6. *Ploiophora.*
3. Fore wing with M_2 and M_3 not stalked; palpi minute in both sexes. 8. *Dryoperia.*

1. Palpus upturned beyond vertex; male often with a notched antenna (**Blastobasinæ**).
2. Hind wings with seven veins; M_3 and Cu_1 fused (fig. 176) ... 5. *Blastobasis.*
2. Hind wing with all veins (fig. 175).
3. M_2, M_3, Cu_1, and Cu_2 all distinctly separate ..... 1. *Euresia.*
3. M_2 and M_3 stalked; Cu_1 free ..... 2. *Valentinia.*
3. M_3 and Cu_1 stalked; M_2 out of the base of the stalk or free.
4. Antenna with eye-cap ..... 4. *Calosima.*
4. Antenna with pecten ..... 3. *Holcocera.*

1. *EURESIA* Dietz

Male antennæ deeply notched, not heavily ciliate. Fore wing with all veins present, all but R_4 and R_5 free; hind wing much narrower, all veins free and widely separate, lower discocellular vein nearly longitudinal and long, as well as **m-cu.**

1. **E. pulchella** Dietz. Fore wing light ochreous, trisected by two vertical whitish shades, the first broader and the second followed by a strong dark shade. 8½ mm. June.
District of Columbia.

2. *VALENTINIA* Walsingham

(*Holcocera* auct., not Clemens; *Auximobasis* Meyrick, in part)

Male antennæ in our species deeply notched at base, scape broad, with a weak pecten. Fore wing normal, with M_2 and M_3 separate; hind wing with M_2 and M_3 stalked; nearly as wide as fore wing, with fringe rather wider than membrane.

1. **V. glanduella** Riley (The acorn moth). Light gray, more or less powdery and mottled; antemedial fascia moderately angled out on Cu, the following blackish shade broken there, so that there appears to be an extension outward of the antemedial line between its two halves. A blackish dash toward base below fold; erect costal and dorsal bars just beyond the distinct small black discal dots, and fairly defined on inner side. Margins more or less edged with blackish at apex; first discal dot also distinct in light specimens. Hind wing much yellower, olive gray, 15–25 mm.

July. Larva in acorns, apparently sometimes a scavenger after the acorn weevil. Distribution general. New York: Ithaca.

2. **V. quaintancella** Dietz. Much smaller than *V. glandulella;* hind wings narrower, fringes twice as wide as membrane. Duller, brownish, more evenly powdery; antemedial line followed by a strong continuous angulate dark shade, the middle part formed of the large diffuse first discal dot; outer discal dots smaller and well marked, the outer markings obscure. Moth resembling a Pigritia. 10–14 mm.

Larva in mummy apples.

Distribution uncertain.

3. *HOLCOCERA* Clemens (restricted)

Similar to Valentinia, except as noted in key. The notch varying in development and not always present.

The following key is incomplete.

Key to the species

1. Ground white, marked with black.
   2. A complete heavy black antemedial band including first discal dot. **3. *confluentella.***
   2. Antemedial band separated from orbicular; or band lighter brown.
      3. No black powdering; a distinct dark streak on R and no antemedial band. **17. *melanostriatella.***
      3. Heavily black-powdered; antemedial band present; dash, if present, short, clean-cut, and confined to antemedial region.
         4. All black and white; black dashes conspicuous.....**13. *elyella***
         4. With brown base of costa and antemedial shade, or suffused with gray. **7. *busckiella.***
1. Ground luteous; notch moderate.
   2. With strong, complex, and contrasting marks.....**6. *chalcofrontella.***
   2. Nearly evenly powdered.....**9. *gibbociliella.***
1. Ground reddish buff.....**10. *villella.***
1. Ground gray.
   2. Male antennæ with deep notch; cilia as long as width of shaft.
      3. Wing-scales not white-tipped.....**1. *dives.***
      3. Scales white-tipped.....**2. *aphidiella.***
   2. Male antennæ with moderate notch; cilia half as long as width of shaft.
      3. Larva on apple; moth immaculate except for three discal dots. **8. *maligemmella.***
      3. Larva on *Rhus;* moth with marked mottling.....**6c. *fumerella.***
      3. Larva on chestnut; moth dark gray, but with ground contrasting luteous on basal third and here and there outwardly.....**6a. *minorella.***
      3. (*H. quisquiliella* also belongs in this group.)

2. Male antennæ without notch.
3. Even, dark mouse gray, with faint darker dots.....11. *funebra.*
3. Paler, more or less dusted with white.
4. Basal dash present.....14. *zelleriella.*
4. No basal dash.
5. Evener, antemedial band distinct toward costa and inner margin, and pointing well before orbicular spot.....*punctiferella.*
5. Rougher looking; antemedial band, when distinct, with its two halves pointing directly to orbicular.....16. *tartarella.*

I. *Notch on male antennæ deeper than width of shaft, outwardly distorting the shaft; cilia as wide as shaft.*

1. **H. dives** Dietz. Mouse gray, the costa distinctly browner; black discal dots only distinct; outer margin and fringe vaguely barred; no white-tipped scales. 16–19 mm.

July.

Toronto, Ontario; New York; Pennsylvania; Indiana.

Var. **basipallidella** Dietz has a distinctly paler basal two-fifths, with angled outer boundary; and the first discal dot indicated at its angle.

New Hampshire; Cohasset, Massachusetts; Pennsylvania.

2. **H. aphidiella** Walsingham. Similar to **H. dives**, many scales white-tipped, defining a vague pale antemedial region; base and middle of costa solid dark; also orbicular and discal dots, some apical shades, and a vague bar on **Cu** outwardly. 13 mm.

July. Larva in a Phylloxera gall on Carya.

District of Columbia; New York: Rock City.

3. **H. confluentella** Dietz. Ground pure white, crisply dusted and mottled with black. Base black, thorax with black anterior and posterior bars; antemedial fascia broad, complete, covering orbicular, angled out at middle; discal dots and postmedial bands fused into a Y-shaped black fascia, which may break into two costal spots and a discal and dorsal bar, or form two anastomosing bands, enclosing a pale spot beyond end of cell. Some black terminal suffusion.

June and July. Larva on pitch pine, associated with *Rhyacionia frustrana* and Recurvaria.

Central New York; Pennsylvania; Massachusetts.

II. *Notch moderate, not as deep as width of middle part of shaft; shaft stouter, with cilia about half as long as width of segments.*

4. **H. purpurocomella** Clemens. Mouse gray, dusted with paler and darker, with distinct first and second discal dots only; very slight purple iridescence. 18 mm.

June.

Pennsylvania; Maryland. New York: Rock City, Vandalia.

5. **H. ochrocephala** Dietz. Mouse gray. Head and collar clay-color; strongly contrasting; middle half of thorax clay-color; front and back grayish; tegulæ clay-color, with gray spot and dusting; base of fore wings clay-color, the wing with obscure orbicular and outer discal dots, not defined with pale. 16 mm.

August. Type only seen.

Maryland; West Virginia.

6. **H. chalcofrontella** Clemens. Typically clay-color, more or less dusted with blackish; orbicular a black dot, with a blackish shade before it on costa and two obliquely placed and more or less confluent patches just beyond it on dorsal half, below **Cu**; two black discal dots, a blackish patch between the lower one and its anal angle; a curved blackish band half way between end of cell and apex, curving in below along outer margin and reaching nearly or quite to the anal patch. More or less distinct blackish terminal dots around apex. Fringe and hind wing

mouse gray. Outer markings sometimes replaced by a continuous, less-contrasting postmedial line, and the inner by an antemedial one interrupted over the cell. 12–16 mm.

Var. **fumerella** Dietz is nearly even mouse gray, powdered in two shades, the marks as in the type, with a continuous strongly curved postmedial line. Var. **quisquiliella** Zeller is pale, more evenly and less contrastingly powdery; the marks all obscure except the three discal dots (perhaps it is a good species).

General. Larva in sumac heads. Moth in July.

New York: Ithaca.

H. minorella Dietz is probably a good species. It is suffused with dark gray, except in irregular patches and on the basal third, the three discal dots contrasting. The larva lives in chestnut burs.

7. **H. busckiella** Dietz. White, more or less dusted with black and suffused with gray, but always with some pure white scales. Normally with base of costa light brown, antemedial fascia blackish on costa, weak or broken on cell, light brown and rather distinct below; orbicular a black dot, and rather beyond it a blackish patch resting on costa between orbicular and reniform, often strongly contrasting. Two normal discal dots; postmedial fascia with its ends just beyond the outer discal dot, its middle curving out nearly half way to apex, the fascia normally heavy and blackish. Terminal dots light. 16–20 mm.

July and August.

Plummer's Island, Maryland.

8. **H. maligemmella** Murtfeldt. Wings broad (fore wing less than four times as long as wide), light yellowish fuscous, with the discal dots distinct; otherwise practically immaculate. 14 mm.

Moth in July. Larva in buds of apple.

Columbia, Missouri.

9. **H. gibbociliella** Clemens. Luteous, lightly dusted with blackish, a little more heavily on outer half, leaving costa paler at two-thirds way out, and outer margin paler on both costa and dorsum; discal dots obscure, the orbicular rather more distinct, rarely absent. Head and thorax concolorous. 11–15 mm.

Atlantic States.

10. **H. villella** Busck. Unicolorous light yellowish brown, immaculate; palpi blackish on outer side, hind wings grayer, with yellowish fringes. Tarsi marked with blackish on outer side. 15 mm.

Larva on *Andromeda ligustrina.*

Maryland. New York: Ithaca.

III. *No antennal notch, cilia normally short.*

11. **H. funebra** Dietz. Mouse gray, slightly powdery, showing the usual three discal dots only. 12 mm.

Var. **reductella** Dietz is paler, less shining, and with the basal third slightly paler. Manitoba.

May to July.

Maryland; Pennsylvania. New York: Rock City.

Dives, aphidiella, funebra, and *purpurocomella* are very similar, practically identical in the female, but *funebra* is rather strongly frosted with white-tipped scales and the third joint of the palpus is notably shorter than the second (three-fourths as long), while in the other three the segments are nearly even in length; *purpurocomella* and *dives* are larger and noticeably stouter than the other two (expanse normally over 15 mm. *H. dives* is the largest and purplest, and shows only the faintest trace of discal spots.

12. **H. boreasella** Dietz. Fuscous, the inner margin below the cell somewhat contrasting, whitish, crossed by an oblique fuscous costal shade from the middle of cell to the inner margin at a third way out. Usual dots diffuse and obscure. No

r distinct markings. The antemedial brown shade bends at an angle on the and is obscurely continued to the costa.
ugust. (One cotype only seen.)
ontreal, Canada; New Hampshire.
3. **H. elyella** Dietz. White, lightly powdered with black; black dashes near below Sc, and in fork of A, orbicular and discal dots horizontally elliptical, rasting, black; a blackish shade in fold below orbicular, and one before it r costa; some dark gray shading outwardly near margin. Usually with dis- t dashes between the radial veinlets beyond orbicular and upper discal dot. d wing light. 13–16 mm.
uly and August.
ublin, New Hampshire, to Maryland.
4. **H. subsenella** Zeller (as determined in United States National Museum). e powdery ash gray, the margins contrasting dark gray, especially outwardly; emedial fascia moderately excurved, interrupted over cell, running well before orbicular, which is a dot; two discal dots and one on Cu half way out from icular to lower discal dot; no other definite marks. 11–14 mm.
August.
Pennsylvania; Texas.
H. zelleriella Dietz, described from Texas, Iowa, and Louisiana, may reach our a. It is similar but with one or two dark dashes at the base, the stronger one the fold.
15. **H. vestaliella** Dietz. White; antemedial fascia indicated by dashes in cell d fold, and shades on margins, angled out at middle or reduced, and pale brown, metimes nearly absent; a dash beyond it on lower side of cell. Discal dots con- icuous, with a black spot below them and a small dash above. Middle of costa aded with brown; outer margin somewhat shaded with black.
June and July.
Southern Massachusetts; Maryland; Pennsylvania.
16. **H. tartarella** Dietz. Mouse gray, somewhat powdered with white; occasion- ly with contrasting whitish basal third; antemedial fascia angled out, formed separate shades running to costa and inner margin, and an orbicular dot; metimes also with a separate dot in the fold. Discal dots and dash on Cu stinct; the other marks obscure. Thorax concolorous, light gray. Marks in the arkest specimens defined with whitish.
End of May to July; September.
Plummer's Island, Maryland.
17. **H. melanostriatella** Dietz. Pearl gray, somewhat shaded with light gray, at not dusted with black; a dark gray shade, variable in distinctness, on base f upper edge of cell, and sometimes at middle of wing. Orbicular black. Discal ots, at least the upper, black; the other marks gray and slight. 15 mm. (*melon- striatella* Dietz, misprint.)
August.
Southern Connecticut; Pennsylvania; Maryland.

The following species of Holcocera are wholly unknown to me; some may be ynonyms.

H. modestella Clemens. Ground even, fuscous; basal part of fore wing paler and rayer; a dark fuscous orbicular and two discal dots. The outer boundary of the ale base angled out but not reaching the orbicular (group II). 16 mm.
Atlantic States.
H. inclusa Dietz. Similar to *H. modestella;* gray with paler base, and excurved ntemedial fascia not reaching orbicular, but without antennal notch. No dot utward on Cu. Ground nearly white, but heavily overlaid with gray; no basal lashes. 15 mm.
Pennsylvania.

H. messelinella Dietz. Gray, sprinkled with whitish scales; thorax whitis dark brown in front; fore wing with antemedial fascia strongly angled, part breaking into costal and dorsal dashes; orbicular spot with two dashes before above and below fold; postmedial fascia dark, angulate. 15 mm.
Maryland; Florida.

H. m. var. **spoliatella** Dietz. More glossy; marks less distinct; the basal strea obscure; front of thorax concolorous. 12–13 mm.
New Jersey; Pennsylvania.

H. clemensella Chambers. The unique type is now greasy, but this seems to be white species.
Kentucky.

H. illibella Dietz. Gray, dusted somewhat with white and fuscous. Antemedi fascia reduced to dots on margins; orbicular and discal dots more distinct; pos medial fascia obsolete. 12–13 mm.
Maryland.

H. punctiferella Clemens. White, with five black bars, arranged 2, 1, 2; groun dusted with gray toward apex, and shaded with yellowish flesh color in fringe and fringe at least of hind wing gray. (The five bars are the orbicular ar one nearly opposite it in the fold, a spot on **Cu**, and the two discal dots.) 12 mm
Pennsylvania.

H. triangularisella Chambers. Grayish fuscous; third segment of palpus whitis Antemedial fascia a broad brown-powdered whitish triangle, resting on the inne margin, followed by a dark brown triangle, resting on the costa. Outer part o wing powdered on a whitish ground; discal dots minute. 18 mm.
Kentucky.

4. *CALOSIMA* Dietz

Like Holcocera but with fully scaled eye-cap in place of a pecten on the antenna Fore wing immaculate.

1. **C. argyrosplendella** Dietz. Yellowish white. Head white, shining; palpi duste outwardly with fuscous. Antennæ gray; eye-cap white. Fore wing shading int pale reddish brown outwardly; hind wing pure white, nearly as wide as fore wing 11 mm.
July.
Pennsylvania; Louisiana; Florida.

5. *BLASTOBASIS* Zeller

(With *Epistetus* and *Prosthesis* Walsingham)

Similar to Holcocera, but with M_3 and Cu_1 completely united. Our species have male antennæ without a notch; cilia of male antennæ as long as width of shaft fore wing with M_2 well separated, M_3, Cu_1, and Cu_2 connate; hind wing with M short-stalked (fig. 176).

1. **B. plummerella** Dietz. Ground powdery smoky brown, strongly shot with purple; nearly even, but with a paler shade across the disc at two-fifths way out and one above anal angle. No definite markings as a rule; the most definitely marked specimens with a small black orbicular and two discal dots. 10–14 mm.
July.
Maryland. New York: Rock City.
Var. **fuscopurpurella** Dietz is large and practically immaculate, with the purple rather strong, and the dark element of the ground strongly predominant.

2. **B. sagittella** Dietz. Gray, speckled with dark brown; a pale antemedial fascia, a little nearer the base at costa, angled out, and sharply extended along Cu in a tooth; a heavy dark shade on its outer side. Base paler, edged along both

ins with blackish, and with a weaker streak below the fold. Outer part of a little darker along costa, with distinct discal dots and terminal dots.

m.
gust. Unknown to me.
zelton, Pennsylvania. New York: Rock City.

6. *PLOIOPHORA* Dietz

lpi of male closely upturned nearly to middle of front, lying in shallow ves on the lower part of the face, and roofed over by the long, overhanging ture (usually falling forward at death); second segment with a large uely oval sensory area on inner side; third segment small. Female palpi and characters as in Pigritia.

P. fidella Dietz. Fuscous gray, smooth and shining; antemedial fascia nearly ight, diffuse, and very slightly inwardly oblique from cell to inner margin, bent ell and slanting in to costa also; the fascia formed of pale dusting, and variable trength; discal dots dark, obscure; outer third of inner margin and outer sixth sta with scattered white-tipped scales, extending somewhat into fringe. 12 mm.

me.
cannot distinguish *P. ampla* Dietz by the one rubbed type I have seen; *fidella* ossibly a synonym of it.
orthern New Hampshire and Parry Sound, Ontario, to Pennsylvania. New k: Rock City.

7. *PIGRITIA* Clemens
(With *Epigritia* Dietz)

alpi of male practically obsolete (fig. 179), and of female short and porrect, h third segment variable in length but generally shorter than the second. tennæ not modified. Fore wing (fig. 177) with cell set obliquely in wing, even re noticeably than in the Blastobasinæ; Cu_2 short and running straight to inner rgin. Hind wing sharply lanceolate, half as wide, with **R** and M_1 decidedly ergent, M_2 connate with Cu_1, the cell very weakly closed, M_3 and Cu_1 rarely very rtly separate at extreme margin, normally fused. The genus Epigritia was ed on the relative shortness of the female palpi, a character that has proved angible.

Key to the species

1. Base of wing, except costal edge, contrasting whitish (late July to August).
2. Its outer boundary distinctly excurved.....11a. *heidemannella.*
2. Its outer boundary straight, erect.....11. *ochrocomella.*
1. With a base of ground color at least twice as wide as the antemedial fascia (June).
2. Antemedial band with an outward tooth at middle.....5. *basilarella.*
2. Antemedial band even, usually straight.
3. Band very narrow, extending one-fifth way to base.....8. *tristella.*
3. Band moderate, extending a third way to base.
4. With a complete dark discal bar; antemedial band broad and contrasting .....4. *mediofasciella.*
4. Two discal dots, prominent in a white shade.....3. *laticapitella.*
4. Discal marks obscure; antemedial band narrower, vague, and very faint .....1. *confusella.* 7. *angustipennella.* 9. *spoliatella.*
2. No antemedial band, or only faint traces.....10. *obscurella.*
3. Head and palpi pale.....2. *purpurella.*
3. Head and palpi dark; wings purplish.....

1. **P. confusella** Dietz. Fuscous brown, the antemedial band broad, pale, ere faint and diffuse; some pale scales at anal angle. No other distinct marks. T form looks very much like *P. fidella* but is browner.

June.

Pennsylvania; New Jersey.

2. **P. purpurella** Dietz. Blackish, shot with purple; with more or less distir traces of the usual markings. Head and palpi concolorous. Male unknown. 12 m

June.

Pennsylvania. New York: Rock City.

3. **P. laticapitella** Clemens. Dull fuscous, about the color of *P. fidella;* t scales largely pale-tipped, especially on outer half of wing. Antemedial fasc prominent, straight, erect, pale (the curve shown in Dietz's figure is probably artefact), fairly defined on outer side, but diffuse on basal. Base more solid fuscous; a broad shade of solid fuscous beyond the fascia to middle of wing. Tv blackish discal dots, sometimes obscure, with a bar below them in the fold, s defined by a well-marked pale shade; the apex again darker. Some whitish dustir in base of fringe. 12 mm.

June.

New Hampshire; Pennsylvania; Iowa; Kansas.

4. **P. mediofasciella** Dietz. Practically like the last form, the marks less co trasting antemedial fascia narrower, discal dots fused into a vague vertical ba only faintly defined with pale; white-tipped scaling at apex well marked. 12 mn

July 1.

New Jersey; Pennsylvania.

5. **P. basilarella** Dietz. Pale silvery gray, dusted with pale fuscous. Hea thorax, and costal half of fore wing at base with golden iridescence. Fore win with base paler, and a dark shade beyond the antemedial fascia; a dark streak o fold at a sixth way from base; fascia with a curved projection at the middle; disc dots strong, with a dot below them in the fold, and followed by a waved postmedia shade. Female less iridescent, with third segment of palpus shorter than second first segment fuscous-dusted, second and third pale. 12 mm. (Not seen.)

Pennsylvania; Louisiana; Kansas.

6. **P. ornatella** Dietz. Similar to *P. laticapitella* and *mediofasciella*, the whit antemedial fascia striking, and perceptibly excurved on outer side, almost pur white; discal dots separate, dark, faintly set off; the whole apical region wit white-tipped scales, paler than the base. 11–12 mm.

Hazelton, Pennsylvania.

7. **P. angustipennella** Dietz. Fore wing narrower (less than one-fifth as wid as long). Lighter mouse gray with a slight violet tint; antemedial band erect vague, slightly paler. A vague pale area over end of cell with obscure darke discal dots. 11 mm.

Pennsylvania.

The one type I have seen looks too similar to *P. confusella.*

8. **P. tristella** Dietz. Mouse gray. Antemedial band, of white-tipped scales, but quite narrow; discal dots practically obsolete, vaguely defined by the well-marked white-tipped scales on the outer half of the wing. All the scales with more or less distinct pale tips. 11 mm.

Hazelton, Pennsylvania.

9. **P. spoliatella** Dietz. Identical with *Dryoperia grisella* (of which it may be a venational aberration), except for the stalking of M_2 and M_3. 11 mm. (Unknown to me.)

Hazelton, Pennsylvania.

10. **P. obscurella** Dietz. Fore wing broad, four times as long as wide, mouse gray, immaculate, with ochreous bronzy head and pale palpi. 11 mm.

July 4.

Northern New Jersey; Pennsylvania.

P. ochrocomella Clemens. Basal third of fore wing nearly white, gray at the me base, with contrasting blackish costa and thorax; outer two-thirds blackish, or less powdered with white and often heavily shaded over the end of the leaving the dark discal dots contrasting, and a darker bar halfway between and apex; the region beyond the antemedial fascia contrastingly dark. Dark imens have only the discal bar defined with whitish. The outer boundary of fascia is typically erect, but markedly curved in the usually darker var. **emannella** Dietz. (*Epigritia* Dietz; *E. pallidotinctella* Dietz.)
ite July and August.
outhern Connecticut to Pennsylvania. A pale form occurs in Missouri.

8. *DRYOPERIA* Coolidge

(*Dryope* Chambers, not Desvoidy)

xactly like Pigritia except for the separation of M_2 and M_3 in the fore wing. pi minute in both sexes, a little smaller in the male; first, and often second, t with a triangular tuft below, rough-scaled, third joint shorter, and some-es very small.

Key to the species

. Immaculate ochreous ..... 6. *ochreella.*
. A distinct antemedial fascia with zigzag outer boundary, followed by dark.
2. Fore wing gray ..... 1. *grisella.* 2. *tenebrella.*
2. Fore wing more or less yellowish.
3. Orbicular represented by a distinct dot ..... 5. *discopunctella.*
3. Orbicular obsolete ..... 4. *murtfeldtella.* 3. *fuscosuffusella.*

. **D. grisella** Dietz. Light powdery gray, the costa darker, especially toward e, the dark showing as powdering on a paler ground. Base dark; antemedial cia zigzag, not reaching costa, diffuse inward, outwardly defined by a contrast- blackish shade which is strong at costa and forms a patch in the fold, but is ctically interrupted in the cell. Ground outwardly pale, powdery; the two cal dots formed of the powdering, distinct but diffuse, and followed by a blackish ade across the apex. 12 mm.
April.
Pennsylvania; Missouri; South Dakota.
2. **D. tenebrella** Dietz is very close to the preceding species, of which it may be variety; apparently it is slightly paler, with the dark antemedial shade weaker d not forming so distinct a spot below the cell. 12 mm.
Pennsylvania; Kentucky.
3. **D. fuscosuffusella** Dietz. Pale ochreous, with dark fuscous dusting and shading, ayer than *D. murtfeldtella.* Antemedial fascia of white dusting followed by a ackish patch on the costa, the patch rarely extended diffusely toward the apex; similar patch on inner margin. Outer part of wing normally dusted with white; ith weak discal dots. 11 mm. (Not seen.)
St Louis, Missouri.
4. **D. murtfeldtella** Chambers. Dull light ochre, shaded with pale brown; ante-edial fascia pale, rather narrow, toothed at middle, heavily shaded with brown cept on the tooth, extending faintly across the brown costal edge. Base shaded ith light brown; subterminal region also shaded with light brown; and discal ots faintly indicated by a red-brown shade, all somewhat dusted with whitish. 2 mm. (*ochrocomella* Dietz, not Clemens; *erratella* Dietz).
Pennsylvania specimens are duller clay color, with dark shading and dusting, ne discal dots distinct, the antemedial dark shade excurved, interrupted and

preceded by a longitudinal dark shade in the middle of the wing, the apical
shade most distinct on the margins.
New Jersey to Texas and Nevada.

5. **D. discopunctella** Dietz. Grayish ochreous; antemedial fascia modera
excurved, faint, defined by a darker shade beyond it on costa; orbicular a st
but diffuse dot; two fainter discal dots. 12 mm.
Hazelton, Pennsylvania. (Unknown to me.)

6. **D. ochreella** Clemens. Shining dull ochreous, dusted with reddish sc
Antennæ grayish ochreous; palpi dusted with brownish; fore wing with apex
der; costa reddish fuscous with traces only of the fascia (unknown to me).
Pennsylvania; Texas; Alabama; South Dakota.

9. *PSEUDOPIGRITIA* Dietz

Similar to Pigritia, with similar sexually dimorphic palpi. Fore wing with
shortly stalked with R_4 and R_5.

1. **P. dorsomaculella** Dietz. Powdery gray; antemedial fascia transverse,
gray, broad, and vague, bent out a little at middle discal dots more or less disti
in a vague pale shade. Similar to *spoliatella*. 11 mm.
Dietz describes this species as having three darker diffuse spots along outer
of dorsal margin.
June.
Pennsylvania; New Jersey.

2. **P. equitella** Dietz. Similar to *P. dorsomaculella*, but with markings fai
and without any dorsal spots. Fascia at a third way out from the base. 11 m
July.
Hazelton, Pennsylvania.

3. **P. fraternella** Dietz. Similar to *P. equitella*, but with the fascia farther
at two-fifths. 10 mm.
Hazelton, Pennsylvania. (Unknown to me.)

4. **P. argyreella** Dietz. Silvery white, tinged with ochreous; with the fas
barely traceable, partially defined with darker. 11 mm.
Hazelton, Pennsylvania. (Unknown to me.)

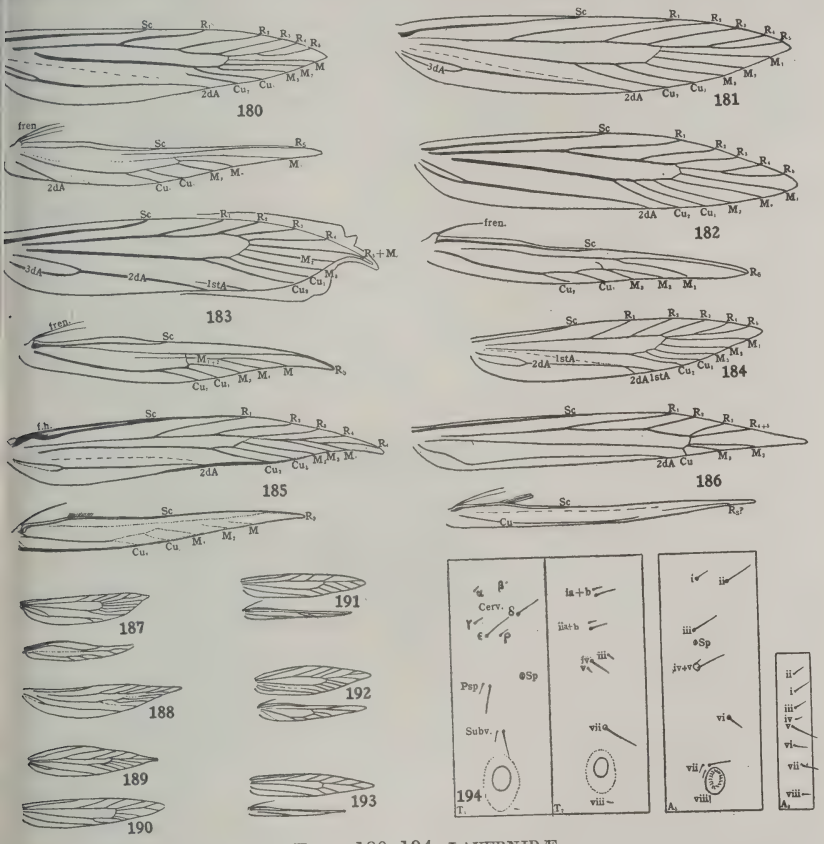
Family 23. LAVERNIDÆ

(Momphidæ; Cosmopterygidæ; Elachistidæ, in part)

Head smooth, the vestiture curving down over the face; eyes modera
or smallish; ocelli variable. Antennæ as in the Gelechiidæ; scape lo
and slender, often with a pecten, which is sometimes reduced to a sing
bristle at its base; never with eye-cap. Antennæ sometimes as long
the fore wing, never much longer or very short. Palpi divergent, wi
second segment smooth or tufted below, but never with a triangul
tuft; third segment variable in length, smooth, upturned, slender, a
regularly tapering; the palpus always upturned and much longer tha
the head.

Fore wing lanceolate, always narrow, the membrane rarely with
blunt apex; with broad dorsal and costal fringe. Anal angle nev
well marked; the apex occasionally caudate (fig. 183), as in the Lyon
tiidæ, some Gracilariidæ, and Polyhymno. R_1 from cell less than thre

rths way to the apex (except perhaps in Synallagma), but rarely sing before middle of the cell; R_2 free, arising well before end of



FIGS. 180–194. LAVERNIDÆ

180, *Walshia amorphella,* venation; **181,** *Limnœcia phragmitella,* venation of fore wing; **182,** *Perimede particornella,* venation; **183,** *Lophoptilus eloisella,* venation and outline of apical fringe; **184,** *Laverna* species, venation of fore wing showing 1st **A** and 2d **A** anastomosing; **185,** *Cosmopteryx scribaiella* (Europe), venation; **186,** *Batrachedra præangusta,* venation (from a European specimen); **187,** *Psacaphora* species, venation; **188,** *Stilbosis tesquella,* venation of fore wing; **189,** *Stagmatophora graboviella* (Europe), venation of fore wing; **190,** *Batrachedra trichella,* venation of fore wing; **191,** *Eriphia albalineella,* venation; **193,** *Eriphia concolorella,* venation; **194,** *Limnœcia phragmitella,* seta map of larva

cell (unlike the narrow-winged Blastobasidæ). R_4 and R_5 stalked, or rarely, united; M_1 often, and R_3 and M_2 rarely stalked with them.

M_3, Cu_1, and Cu_2 almost always parallel and subequal in length, fr an oblique lower outer end of cell. **1st A** rudimentary at the ba but frequently developed as a normal vein at the margin; this margi piece being sometimes very short, and often apparently wholly se rate from the rudimentary base, arising out of **2d A** (fig. 184). **2d** forked at its base, the lower fork occasionally rudimentary. Hi wing narrower, lanceolate to linear, fringe one and one-half to eig times as wide as the membrane. A costal tuft of bristles toward t base, with the margin concave beyond it. **Sc** free from **R**, but occ sionally connected by a cross vein (R_1). (In a couple of exotic speci **Sc** is extremely short and R_1 appears as a free vein running to t costa) **R** and M_1 more or less convergent at their origin; approxima (usually closely), connate, or stalked; M_1 occasionally stalked wi M_2, and the cell often open below them; M_3 distinctly separated fro Cu_1, usually connected by a long oblique cross-vein parallel to t dorsal margin. The anal region reduced, usually with rudiments the normal veins; **2d A** forked when distinct. (When the hind wi is linear the veins are much reduced and their connections oft uncertain).

The caterpillars are quite insufficiently known; they include lea miners, stem-borers, seed-eaters, and, more rarely, leaf-roller Batrachedra and Pyroderces include some scavengers. A large pr portion are associated with the Onagraceæ.

Caterpillar (fig. 194) with head small and depressed, adfront sclerites not quite reaching vertex, ocelli close together; body-set small; ninth segment of abdomen with setæ **ii** farther apart on mid dle line than they are from **i**, and **i**, **ii**, and **iii** in a vertical line thoracic coxæ twice as far apart as their width, prolegs also fa apart, with hooks in a complete circle, normally biordinal. Pup various, but normally with the clypeal suture complete, a quad rangular prothorax not narrowed at the middle, the palpi and th femora fully exposed, and maxillary palpi large, nearly or quite reach ing the tongue. Antennæ meeting on the middle line well before th wing-tip, but not again diverging; cremaster with stout spines.

In Chrysopeleia the characters are nearly those of Aphelosetia, throw ing some doubt on the position of the genus. In that genus the labia and maxillary palpi and the femora are wholly concealed; there ar only a few short straight cremastral setæ, and the wing cases etc., ar soldered to the body as far as the seventh abdominal segment, so that there is probably no motion; but the clypeal suture is as in the Laver nidæ. Cosmopteryx has the prothorax narrowing in the middle line, the maxillary palpi exposed, but the labials and femora concealed, the clypeal suture lost, and a single movable segment. Its cremaster has hooked setæ.

The family as it now stands is undoubtedly heterogeneous, being
nprised of various reduced Gelechioidea, with perhaps a couple of
ıera which really belong to other superfamilies. The forms with
A preserved, or with a primitive pupa, are evidently correlated
h the Œcophoridæ; others, like Ithome, seem to be derived from the
echiidæ by reduction; Batrachedra and Synallagma are most doubt-
in position. A few genera of other families have been added to the
for convenience.

Key to the genera

. Hind wing immaculate; maxillary palpi minute, close-scaled.
2. Fore wing with one or more veins lost.
3. Cell set obliquely in the wing (fig. 186), squarely truncate at end, between R_{4+5} and Cu_1, cubital branches almost invariably running straight across to dorsal margin, much shorter than M_3.
4. Fore wing with R_4 and R_5 stalked; hind wing narrow-lanceolate. **12. Blastodacna.**
4. R_4 and R_5 completely united; hind wing linear (figs. 186, 190). **13. Batrachedra.**[22]
3. Cell central in the wing, the closing vein strongly oblique and nearly parallel to the dorsal margin from M_2 to Cu_2; M_3 to Cu_2 rather evenly spaced, subequal, and parallel.
4. A radial vein lost; only four veins running to costa; fore wing falcate. **15. Synallagma.**
4. One or more dorsal veins absent; R_1 always present.
5. R_3 more or less stalked; M_1 often stalked.
6. Wings broad; hind wing lanceolate and slightly trapezoidal, with two M's lost, and M_3 connate with Cu_1..... (Gelechiidæ — **Helice.**)
6. Wings linear; hind wing with all veins preserved. (Heliodinidæ — **Erineda.**)
5. R_3 free; M_1 stalked..... **11. Chrysopeleia.**
2. Fore wing with complete venation (cell always central, with oblique end).
3. M_1 stalked (fig. 185).
4. Scape of antenna as long as width of head, without a pecten; antennæ longer, more slender. Fore wing with a silver streak in the apex; Cu_2 arising less than three-fourths way out on the cell; M_2 stalked (fig. 185) ..... **14. Cosmopteryx.**
4. Scape half as long as width of head, pecten variable; antennæ usually only four-fifths as long as fore wing, fore wing without a white streak in the apex; with Cu_2 arising more than three-fourths way out.
5. Fore wing with heavy, raised, metallic tufts; M_1 stalked nearly to apex; M_2 free..... **4. Stilbosis.**
5. Fore wing with small, inconspicuous tufts, or none, M_1 shortly stalked unless M_2 is also stalked.[23]
6. Wing dull, linear; pecten strong..... **7. Pyroderces.**
6. Wing shining, lanceolate; pecten absent. **9 Stagmatophora, 10. Ithome.**

[22] Coleophora may be sought here, but is distinguished by its antennæ thrown forward repose, its slender fore tibia without epiphysis at the middle; its upper spurs of the d tibia above the middle, and its more angular-looking palpi.

[23] *Laverna sexnotella* also normally has M_1 very short-stalked, but the second segment the palpus is much thickened, the wing has metallic tufts, and there is a weak pecten.

3. M_1 free from R_5 (fig. 184).
4. Hind wing with M_1 and M_2 stalked (fig. 183), in our species a third wa to apex (when the cell is open, separating well beyond the separatio of M_3 and Cu_1).
5. Fore wing caudate.....5. **Lophoptilus** (part
5. Fore wing not caudate.
6. Palpi smooth, **R** of hind wing running to costa less than three-qua ters way to apex.....6. **Psacaphor**
6. Palpi with second segment slightly tufted below; **R** of hind wi reaching almost to apex.....5. **Lophoptilu**
4. Hind wing with M_1 and M_2 separate, rarely connate.
5. Scaling coarse and heavy, with large raised tufts; palpus tufted.
6. Pecten normal .....1. **Lavern**
6. Pecten of a single bristle.....3. **Walshi**
5. Scaling fine and smooth; palpus smooth.
6. Scaling irregular; pecten weak.....2. **Limnæci**
6. Scaling regularly imbricate; pecten absent.....8. **Perimed**
1. Hind wing linear with silver bars; maxillary palpi tufted.
(Heliodinidæ-**Idioglossa**

For an artificial key to the species related most closely to Laverna, see Laverna

1. *LAVERNA* Curtis

(*Mompha* Herrich-Schæffer; Hübner, in part; *Wilsonia* Clemens)

Pecten well developed; palpi with a rough divided tuft on under side of secon segment, third nearly as long; scape, tongue, and maxillary palpi normal. Fo wing (fig. 184) with R_4 and R_5 only stalked; M_3, Cu_1 and Cu_2 equal, evenly space and normal, from an oblique closing vein. Tip of 1st **A** normally appearing as terminal fork of **2d A**, more rarely free. **A** widely forked at base. Hind wing wi **R** and M_1 approximate at base, well separated from M_2, which is associated with t **Cu**-stem; the wing lanceolate; hind wing, rarely, narrow with weak veins.

Caterpillars mostly associated with the stems and fruit of Onagraceæ.

L. cephalanthiella Chambers is a Psacaphora.

Key to the species

1. Head and thorax white.
2. White patch at base of wing continuous on inner margin to middle.
3. Apical fourth of fore wing mostly white.....2. *definitell*
3. Apical fourth of fore wing dark.....1. *circumscriptell*
2. White basal patch confined to inner margin and extending to one-fourt only, followed by a smaller spot on inner margin.....3. *murtfeldtell*
1. Head white, thorax blackish, contrasting.
2. Fore wing evenly blackish with contrasting white and silver spots.
3. Fore wing with three separate spots on inner margin.....6. *sexnotell*
3. Fore wing with the two outer spots connected.....7. *wyattell*
2. Fore wing lighter brown, the scales white-tipped.
(*Psacaphora cephalanthiella*.
1. Head and thorax concolorous with fore wing.
2. Head and thorax, base of inner margin of fore wing, convergent fasciæ, etc pinkish white, scaled with black.....4
2. Head, thorax, and general ground of fore wing wood brown.
3. Two black dashes on disc and smaller spots in fold .....5. *brevivittella*
3. Tuft in middle of fold forming the largest black mark, no dashes.
4. *stellella*
2. Head and thorax blackish.....8. *decorell*

L. circumscriptella Zeller. Head, including palpi, thorax, and basal half of wing, white; antennæ blackish, with tip of scape white. Outer half of fore g typically rusty-brown (gray-brown in the more northern race). Costal edge vn all the way to the apex, broadly brown at base, the area widening into a ngle at a fourth way out and then very narrow to middle; a white costal ia at three-fourths way to apex, typically connected by a curved white line ı the white at the middle of the wing, where there is a black tuft above and w it. 9–12 mm.; larger northward.
ıne to October. Larva in seed-capsules of Œnothera, in August.
outhern States, north to southern New Jersey, Illinois, and Missouri.

L. definitella Zeller. Similar to *L. circumscriptella;* scape white; palpus with vn outer side of second segment; fore wing with the dark part fuscous brown, al fourth white, with erect denticulate inner boundary, crossed by a blackish ia from just below apex to anal angle, leaving a narrow irregular marginal te band; fringe grayish, with some white scaling at apex. 15 mm. (*unicrista-* Chambers; *ruficristatella* of the New Jersey list).
ily and August.
outhern New Jersey; Texas.

L. murtfeldtella Chambers. Head, palpi, and thorax white, the palpus with narrow black bars on the third segment. Fore wing powdery gray (black on te) and light wood-brown; a semicircular white patch on basal fourth of inner gin, with a black tuft on its outer edge, a smaller patch before middle; with rge black tuft, and a small white and black tuft in fold at three-fourths way apex; small black and white tufts at middle and end of cell, the outer one etimes extended into a black streak, and a similar black streak in the discal beyond it, opposite a white costal spot.
ctober. Larva in buds of Œnothera; dull brownish green, shaded with red, with vn head and plates.
entucky; Missouri; Colorado; Texas.

. **L. stellella** Busck. Similar to *L. brevivittella* but more mottled looking; ennæ unicolored, dark brown; palpi powdery, with a black ring near tip of third nent. Head and thorax light ochreous; face silver white; fore wings light reous mottled with brown and black scales, costal edge evenly mottled with k and apical part evenly sprinkled with black scales; two indistinct oblique t brown shades crossing the wing, from base and middle of costa; six raised reous tufts, in cell and below fold, the middle one of the lower row the largest, minating in black scales, forming the most contrasting markings.
ugust to October, more rarely in the spring. Larva in Œnothera; in the buds, ers, and seed-capsules; maturing in August. Light yellow, transversely banded h pink; with brown head.
ntario to District of Columbia.

. ————————. Head, thorax, and fore wing gray (black powdering on a te ground. Palpus with second segment scaled with gray and black; third ment black, with fasciæ: the base lighter out to the first fascia, but half covered h a larger triangular dark brown area resting on the costa. Antemedial fascia ned beyond by a couple of black tufts; outer three-fifths of wing darker, and vily scaled with wood-brown and chocolate brown; with a black shade through er part of cell, and a vague one beyond the postmedial line to the apex; post-lial line followed by black scales on the discal fold and a black tuft in the median fold. 9 mm.
ctober to April.
ew York: Ithaca.

. **L. brevivittella** Clemens. Wood-brown, the scales of fore wing and thorax ly white-tipped, those of head mostly solid brown. Palpus grayish with a vy black bar on third segment and black tip. Fore wing nearly evenly colored, shaded with grayer and yellower brown; short, longitudinal black dashes in

fold near base, in cell at middle, and in middle of wing toward apex, each wit some raised scales; with raised, black dorsal spots opposite the first two dashe and a little before the third. 11 mm. (*œnotherivorella, œnotheriseminell* Chambers.)

October. Larva in seed-capsules of Œnothera.

New Jersey to Missouri. New York: Ithaca, Albany.

6. **L. sexnotella** Chambers. M_1 shortly stalked, but pecten and tuftings as Laverna. Brown-black; head white; palpus with gray at base, two black rings o third segment; thorax with some white scales; scape white-tipped, and apex antennæ with five white rings on alternate segments. Fore wing with an obliqu white bar from the costa near base, an oblique triangle at middle, and a lar triangular white spot before the apex; raised dorsal silver spots opposite the fir two and just before the third; some white terminal dots, the largest at ape 12 mm. (*Stagmatophora.*)

May to August. Caterpillar a gall-maker in stem of *Trichostema dichotomu* (a mint).

Massachusetts to Ontario and south.

7. **L. wyattella** Barnes and Busck. Similar to *L. sexnotella*, larger; middle an outer spots on inner margin of fore wing connected by white scaling; and whi markings as a whole rather more extensive; hind wing much darker, purplis black with a purple sheen. 13–16 mm. (*Stagmatophora* Barnes and Busck.)

Chicago, Illinois.

8. **L. decorella** Stephens. Black-brown, with two narrow, broken, transvers white fasciæ and some scattered white spots. 11 mm. (*unifasciella* Chambers).

August and September. Larva light gray-green, with blackish head and brow cervical shield; in a stem gall on Epilobium, in July and August.

Quebec to West Coast. Eurasia.

2. *LIMNÆCIA* Stainton

(*Lymnœcia* auct.; *Láverna,* in part)

Head smooth; eyes large; scape slender, almost as long as width of head betwee insertions of antennæ; pecten of few bristles, fugitive. Palpi smooth; third se ment twice as long as second. Fore wing lanceolate (fig. 181) as in Laverna, bu with rudimentary tufts in cell only; **1st A** completely lost. Hind wing two-thir as wide; venation as in Laverna, but with cubitals relatively longer and clos together at origin. Fringe nearly twice as wide as membrane. A very distin genus of Australian affinity; our species cosmopolitan with its food plant.

1. **L. phragmitella** Stainton. Clay-color. Palpus with two slender black lines c third segment; scape with a black line; shaft of antenna with a series of bla dots. Fore wing with small black discal dots, ringed with white, and a weak black point or dash in the fold; fringe barred with cream. Hind wing light gra with nearly white fringe. 20 mm.

Of general distribution, emerging in early July. Caterpillar whitish, with ye lower head and several longitudinal pink stripes; eating in the seed-heads of ca tail, and causing them to fluff out; wintering half grown. One brood.

New York: Lewiston, Ithaca.

3. *WALSHIA* Clemens

(*Mompha* auct.; *Sorhagenia* Spuler)

Similar to Laverna; pecten reduced to a single bristle. Palpus with second se ment practically smooth, but fore wing heavily tufted. Fore wing (fig. 180) wit venation as in Laverna, but Cu, nearer Cu_2 than M_3 at origin; Cu_2 partly lost, easil

staken for **1st A,** which is absent. Hind wing normal; **Cu**$_1$ and **Cu**$_2$ somewhat proximate. The European species (**Sorhagenia** Spuler) has apparently lost **Cu**$_2$ npletely, and is a twig-miner and later a leaf-roller on Rhamnus.

1. **W. amorphella** Clemens. Head, thorax, and basal third of wing smoky black-, somewhat mottled. Antennæ and palpi nearly concolorous. Fore wing with ter boundary of the dark area oblique outward, with a moderate blackish tuft in cell and a very large one on the fold, just before it (unlike Laverna). Outer rt of wing paler, mottled clay-color and light brown, with some black scaling, ıding to leave a somewhat paler, outwardly oblique median fascia, and a vague)ken angulate subterminal one. Median fascia with a large transverse tuft across e cell, and a small one below the fold; a black dash in the fold just beyond them. small tuft at end of cell. Terminal dots black. Many of the scales white-tipped, ıst strikingly at the margin. 15 mm. (*miscecolorella* Chambers.)

May; July. The caterpillar forms a gall on *Amorpha fruticosa*, pupating in the ll. (H. p. 430, f. 249.)

New Jersey to Minnesota and Missouri. New York: Ithaca.

4. *STILBOSIS* Clemens

No pecten, scape rather long and slender. Palpi long, smooth, and slender; third gment as long as second. Fore wing heavily tufted, in our species with strongly tallic vestiture, the tufts as in Walshia but larger, and tending to fuse in pairs. re wing narrow (fig. 188) four times as long as wide; costa slightly concave; stalked with R_5 nearly to apex; **Cu**$_2$ obsolescent at base, but not approximate to A_1; **1st A** lost. Hind wing a third as wide as fore wing, linear, with concave sta; **R** obsolescent, apparently long stalked with M_1; the remaining veins sepa- te; fringe five to six times as wide as membrane.

1. **S. tesquella** Clemens. Shining dark lead-color; antemedial tufts black; median ıd discal tufts in large straw-yellow patches, the latter connected with a straw- llow costo-apical spot. 9 mm. (*quinquecristatella* Chambers.)

May to July; August. Caterpillar between leaflets of *Amphicarpa monoica* and spedeza; light yellow, with concolorous head, black shields, tubercles and true gs. July.

New York and North Carolina to Minnesota. New York: Ithaca; Sea Cliff, ng Island.

5. *LOPHOPTILUS* Sircom

(*Cyphophora* Herrich-Schæffer; *Leucophryne* Chambers; *Laverna*, *Mompha*, in part)

Palpus nearly smooth, third segment three-fifths as long as second. Similar to averna. No pecten; **1st A** of fore wing (fig. 183) stalked or free, well developed; ind wing three-fifths as wide as fore wing; **R** running to costa a short distance efore apex; M_1 and M_2 stalked, widely separated from M_3; upper and lower dis- cellular veins transverse. Tufts on fore wing normally heavy; fringe normally en.

L. eloisella and *passerella* are strongly aberrant in having minute raised tufts nd a strongly caudate apex, and perhaps should be separated generically. The rvæ, so far as known, feed on Onagraceæ.

Key to the species

1. Ground white, apex caudate.
   2. An antemedial fascia; smaller ..... 3. *passerella.*
   2. Two antemedian black dots; larger ..... 2. *eloisella.*
1. Ground gray, apex not caudate ..... 1. *tricristatella.*

1. **L. tricristatella** Chambers. Dull brown, slightly shining, the scales of t paler portion pale-barred and tipped. Markings mostly indefinite. Inner marg slightly paler toward base, apex distinctly paler, tending to show a pale su terminal costal patch. The principal tufts are a median one below fold, and o at end of cell. 20 mm. (*grandisella* Chambers, *subiridescens* Walsingham.)

May and June.

Ontario to District of Columbia and Colorado. New York: Uphill Brook (M Marcy).

2. **L. eloisella** Clemens. White. Palpus with two black bars. Fore wing wi black dot at base, one on costa a fourth way out, and a small tuft on the fo opposite it. Outer half heavily streaked with yellow-brown; two broad strea converging on apex from costa at three-fifths and four-fifths way to apex, ea sometimes divided into two lines; two finer lines beyond middle of disc, meeti at the upper edge of a large brown, white, and gray tuft three-fourths way ou A smaller black spot near middle of inner margin, followed by a brown triang just reaching this tuft; a powdery gray patch below apex. Fringe with a stro black pencil projecting from apex; with two triangular teeth on costal side, ea edged with black. The yellow-brown may be partly replaced with black. 15 m (occasional dwarfs, 8 mm.)

Generally distributed; in June. Larva yellowish white, with red-brown hea in pith of Œnothera stems, wintering in the dry stems.

3. **L. passerella** Busck. Venation as in Psacaphora; wing-form and pattern as *L. eloisella*. Pecten present. White; palpus with a gray spot on second segmen fore wing with two black dots at base, a streak on costa a third way out, a bro light brown median fascia, and a postmedian one separated by a narrow whi area, both further out in the middle, irregular, and defined with black scal Apex with mixed brown and black-and-white-barred scales, with a longitudin black streak from the outermost dorsal tuft to the apex. A transverse black li across fringe at apex. Basal two-thirds of hind wing black, the rest fuscou 7 mm.

East River, Connecticut. New York: New York City (Watson).

6. *PSACAPHORA* Herrich-Schæffer

(*Lophoptilus, Laverna, Mompha,* in part)

Pecten rudimentary. Palpi rather thick, but smooth, third segment muc shorter than second; venation as in Lophoptilus, but with **R** of hind wing reac ing costa only two-thirds way to apex, like R_1 of Tinagma. **1st A** stalked (fi 187). Fore wing typically with slightly raised metallic markings.

Key to the species

Ground orange ..... 3. *terminell*
Ground powdery gray and brown ..... 1. *cephalanthiella,* 1. *luciferell*
Ground black, metallic bands contrasting ..... 2. *argentimaculell*
Ground white ..... (*Lophotilus passerella*

1. **P. (?) cephalanthiella** Chambers. Powdery gray, obscurely mottled. Hea cream-white, contrasting. Fore wing with markings all obscure, the distinctes being dark dashes in fold at base, and in middle of wing toward apex, of blac scales and an antemedian silvery white spot in cell, one in fold before middle, an one at end of cell. Some of the dark scales also shining lead gray in some light **Black dorsal tufts at two-fifths and three-fourths way to apex. 7 mm.**

September and October. Caterpillar on button-bush in September and earl October, in a blotch mine; pupating and emerging very soon. Larva with ligh

l-brown head, and body with crimson dorsal line and spots. Hibernation appa-tly in the imago.
'his is probably a synonym of *luciferella* Clemens, described from New York . Pennsylvania, in June.
outhern Ohio.

. **P. argentimaculella** Murtfeldt. Shining dark brown, with a good many of scales toward apex finely white-barred; a broad lead gray antemedial fascia oss middle of cell, with a large blackish tuft in fold beyond it; a strongly gular postmedial fascia, sometimes Y-shaped, or with a separate costal spot ore it, and sometimes broken in middle, with a large tuft beyond it on inner rgin; with a small yellow area before it, or in the fork, if it is forked; a nar-er strongly irregular subterminal band, produced out at middle. Fringe ite-tipped. 7 mm.
End of August; December (forced?). Caterpillar a leaf-miner of Œnothera, in gust and October; mine a winding tract, often recrossing itself and sometimes oming confluent into a blotch, with scattered frass; larva pale green with three istinct pink dorsal stripes. Pupa in a dense white cocoon, usually outside the ıe in a wrinkle of the leaf.
St. Louis, Missouri.

. **P. terminella** Westwood, race **engelella** Busck. Deep bronzy brown; palpi .e powdery gray; antennæ with a white band before apex. Fore wing bronzy on al fourth, the rest bright yellow (metallic and changing from green-gold to per), shading into dark brown at apex. An oblique silvery fascia at base, ving out to meet the antemedial fascia, one at a fourth way out below fold, l an equally long one at three-fourths way out; two large black tufts on dorsal lf of wing, just beyond the two fasciæ, with a silver dash between them; a white tal dot before apex. Orbicular silver, slightly raised. Base of dorsal fringe d gray. 8 mm.
May; June. Larva (Europe) whitish with yellow-brown head, in a greenish tch mine on *Circæa lutetiana*.
Connecticut to District of Columbia and western Pennsylvania. New York: ck City (Cattaraugus County), Hemlock Lake, McLean.

7. *PYRODERCES* Zeller

(*Batrachedra*, in part)

Pecten strong, scape short; fore wing narrow-lanceolate and subfalcate; R_1 to M_2 ılked, R_5 and M_1 farthest; M_3, Cu_1, and Cu_2 parallel and equal; 1st A free, 2d A ·ked at base. Hind wing half as wide as fore wing, with concave costa and some-ıat weakened veins; R and M_1 long-stalked; M_2 somewhat approximate to them. terpillars various. Palpi with second segment somewhat roughened, third a tle longer.

1. **P. rileyi** Walsingham. Bright yellow-brown, palpus with third segment pale th three black rings. Fore wing with irregular and incomplete black bands at e-fourth and one-half way to apex, typically followed by luteous, and with a nilar rudimentary mark on the costa before the first band, sometimes joined to Terminal region with two pale patches, each followed by a black one running t toward apex. A couple of black bars in fringe. Markings sometimes more scure, the luteous being masked by a powdery extension of the black. Black wdering rarely gathering in a broken longitudinal streak.
Larva feeding in mummy fruits of loquat, rotten cotton bolls, stored corn, etc.
District of Columbia to Arkansas and south; common in the tropics.

8. *PERIMEDE* Chambers

(*Mompha*, in part)

Similar to Laverna; scape rather long, without pecten; palpi smooth, with seco segment slightly thickened, and third a little longer. Fore wing lanceolate (hard four times as long as wide, fig. 182), normal, obscurely tufted, with 1st **A** los hind wing half as wide as fore wing, with **R** and M_1 and M_2 and M_3 connate.

Key to the species

1. Antenna white-tipped ..... 1. *particornell*
1. Antenna dark.
   2. Fringe wholly dark ..... 2. *erransell*
   2. Fringe below apex white ..... 3. *falcat*

1. **P. particornella** Busck. Shining lead gray; immaculate; terminal eight ten segments of antenna white. No other pale scaling. 12–15 mm.

End of May.

District of Columbia and vicinity; Texas.

2. **P. erransella** Chambers. Dark lead gray (with slight purple iridescence the tufts very slightly defined with yellow or whitish scales; sometimes with costal subterminal spot.

July and August.

New Hampshire to District of Columbia and Missouri. New York: Ithaca.

3. **P. falcata** Braun. Fore wing purplish fuscous, powdered, on a shining gravi white base. Similar to *P. erransella* and *P. particornella*, but with a contrastin white patch in fringe below the apex, and with antennæ wholly dark. Hind wi mottled with white beneath. 11½ to 14 mm.

June and July.

Cincinnati, Ohio; Pittsburgh, Pennsylvania; New York: Ithaca.

9. *STAGMATOPHORA* Herrich-Schæffer

Similar to Perimede; palpi more slender in our species, with second segmen slender and as long as third. Fore wing with M_1 short-stalked (fig. 189); narrow scaled and green-iridescent, with very obscure, practically obsolete tufts. Fo *S. sexnotella* see Laverna.

Key to the species

M_2 stalked (Cholotis) ..... 2. *ceanothiell*
M_2 free (Stagmatophora) ..... 1. *gleditschiæell*

1. **S. gleditschiæella** Chambers. Dark bronzy, with some greenish iridescen on thorax and fore wing; immaculate, the rudimentary tufts slightly duller. Ana tuft and hair on hind tibia orange in male. 12–15 mm.

May. Larva boring out thorns of Gleditschia.

District of Columbia; Ohio; Kentucky.

2. **S. ceanothiella** Cosens. Practically identical, except for the venation, wit *S. gleditschiœella*. Basal joints of antennæ long and enlarged at tip (*Pyroderces Cholotis* Meyrick).

End of May. Larva in a gall in a distorted terminal bud of Ceanothu (Ontario); also in a slight gall in the stem (Texas). In the former case winter ing in the gall. Light yellow, with black head and two light brown triangles c neck.

Vicinity of Toronto, Ontario; Texas.

10. *ITHOME* Chambers

(*Eriphia* Chambers, in part; not Latreille, Meigen, or Felder)

imilar to Stagmatophora. Fore wing shorter, short-lanceolate pecten appar-ly present but fugitive. Venation apparently unstable in the number of lials preserved and in degree of stalking of M_1. Cu_2 arising near angle of cell. id wing with **R** and M_1 long-stalked.

. **I. unimaculella** Chambers. Dark smoky; a small subterminal pale spot on wing. Third segment of palpus with a series of pale dots on under side. im.

his species has been confused with *I.* (*?*) *concolorella* and even with the usually ch larger *Perimede erransella*, but is distinguished by the palpi.
outhern States; northern distribution uncertain.

11. *CHRYSOPELEIA* Chambers

(*Æœa* Chambers)

palpi rather long and slender, somewhat rough, third segment shorter than ond. Wings with small tufts; fore wing with M_1 long-stalked with R_5; M_2 lost; normal; cell central; hind wing linear-lanceolate; **Sc** obsolete; M_1 long-stalked h **R**, which runs to apex; the other veins present, apparently arising from stem.

he larva forms a large blotch mine between two veins, starting usually with ract along the midrib. It forms a frass tube along the midrib, with two walls frass extending from it to the margin of the leaf.

his genus is perhaps a reduced Gelechiid, and appears related to Helice.

. **C. ostryæella** Chambers. Face, palpi, legs, and under side pale hoary gray; tex, antennæ, thorax and fore wings dark powdery steel gray; base of inner rgin paler. A paler fascia before the middle, farther out and wider toward er margin, and a nearly parallel, doubly curved fascia beyond apical third; x pale, with minute dark tufts in dorsal fringe. Four principal tufts on wing face, arranged in a diamond, the two basal ones lying along the inner side of first fascia, and the dorsal one farther out. 6 mm.

Iay to August; commoner later. Larva yellowish-white, with brown dorsal ts in front, and a spot on mouth parts; on iron wood (Ostrya) in September.
Kentucky; southern Ohio.

. **C. purpuriella** Chambers. Very close to *C. ostryæella*, the two basal tufts idistant from base, the antemedial fascia weaker or absent, and the apical one re solidly pale. 6 mm.

June; end of July. Larva in July and late September; with habits like *C. ryæella*, but the mine less regular in form; on red oak.
Kentucky.

12. *BLASTODACNA* Wocke

(*Mompha*, in part)

similar to Laverna; pecten present, palpus with second segment a little rough-d. Fore wing unlike all the preceding genera and like Batrachedra in having cell squarely truncate; Cu_1 and Cu_2 connate from its lower angle. Two large sal tufts, **1st A** stalked from **2d A.** Hind wing with M_1 and M_2 stalked.
he larvæ are bud-worms and fruit borers on Cratægus and related Rosaceæ, l have dense secondary hair besides the usual setæ.

. **B. curvilineella** Chambers. Rather even, powdery, light gray, with two black ts; sometimes with a dark dash beyond the first, but with no yellow shading. im.

Larva densely hairy, Platyptilia-like, in berries of Cratægus. The pupa hib nates and the moth emerges in the spring.

Kentucky. New York: Ithaca (Wellhouse).

13. *BATRACHEDRA* Stainton.

Fore wing typically almost linear (fig. 186); but lanceolate in some of o species; palpi long, second and third segments equal; no pecten (except in so aberrant species); fore wing with cell oblique in wing, at its outer end separat from dorsal margin by only half its width, the end perpendicular; R_4 and R_5 co pletely fused, M_1 typically stalked with them, free in *B. placendiella*. One medi lost, Cu_1 and Cu_2 typically connate, and sharply divergent, Cu_2 running direct across to inner margin; M_3 closely approximate or connate, and much longer. (*B. trichella* Cu_2 is well back from the end of the cell, and M_2, M_3, and Cu_1 a longitudinal, parallel, and more nearly equal than usual. M_1 is long-stalked Hind wing in *B. placendiella* as in Blastodacna; in the others linear, with reduc venation. Larvæ variable in habits, frequently scavengers. Epiphysis of fo tibia, in the typical group very small, at middle of tibia, and strongly prominen more normal in *B. placendiella*.

The genus is heterogeneous and of doubtful relationship; it is sometim associated with the Coleophoridæ. *B. placendiella* is clearly related to the Lave nidæ, but may not be very close to the other species.

I. *Wings lanceolate;* M_1 *free,* M_2 *lost; epiphysis normal; pecten strong; anten with raised whorls of scales; palpi not strongly divergent; ovipositor exserte*

1. **B. placendiella** Busck. Palpi blackish fuscous, third segment with an ochreo annulation at base, and extreme tip ochreous. Antennæ dark fuscous with narro black annulations. Thorax dark fuscous; head light and iridescent; fore wing blac ish fuscous, *nearly evenly* powdered with pale; without a pale central stripe; sm black tufts in fold at middle, on inner margin at three-fourths way to apex, a at end of cell; a black terminal line around apex, fringes light with a black li in them. Abdomen concolorous, with yellow tip. 11 mm.

June.

Western Pennsylvania.

II. *Fore wing lanceolate* (fig. 190) *with* M_1 *apparently stalked,* M_2 *present,* M_3 a Cu_1 *longitudinal; hind wing linear with crowded venation; maxillary pal turned laterally; antennæ smooth, scape short, no pecten.*

2. **B. trichella** Busck. Palpi light ochreous with a small dark spot on side second segment; antennæ rather darker; head and thorax light ochreous. Fo wing light ochreous at base, shading into purplish brown at tip, basal third costal edge black; a short longitudinal black streak in middle of wing at thre fourths way to apex, and an obscure oblique one at base of fringe; the wi sparsely dusted with black. Fringe, hind wing, and legs light ochreous; abdom fuscous. 15 mm.

August.

Western Pennsylvania; southern Ohio.

III. *Fore wing practically linear (fig. 186);* Cu_2 *very short and transverse; hin wing linear with venation almost obsolete and the scale tuft prominen one-fifth way out from base; epiphysis small and prominent; palpi turne laterally; antennæ smooth, without pecten; maxillary palpi porre* (Batrachedra).

3. **B. salicipomonella** Clemens. R_5 and M_1 separate; antennæ dark fuscous, wi white annulations except at tip; palpi dark fuscous; second segment with a whi ring at tip and sometimes at base; third with a more or less distinct central rin and whitish tip. Head fuscous, face white. Fore wing powdery fuscous, with

r, sometimes obscure stripe through the middle to outer margin and apex, with blackish discal dot on its upper edge, and a larger black spot on its lower at two-fifths way from base to apex. 10 mm.
terpillar inquiline in willow galls, especially the saw-fly gall on the leaves. te with a broad transverse black band on the front edge of each segment, the band placed on the mesothorax, and interrupted in middle; eighth segment bdomen with a band on posterior edge also. Head yellowish, venter pale; aculate; legs normal. Hibernation as larva; imago emerging in May. The a apparently destroys the maker of the gall.
nerally distributed; a paler race (*striolata* Zeller) in Texas. New York: æ at Ithaca.

B. præangusta Haworth. Luteous; head, body, palpi, and fore wings heavily ed with blackish; not forming a distinct pattern, but distinctly darker on r half of basal half of fore wing. Typically with scattered spots of plain ous, which are obsolete in our race.
me. Larva (Europe) white, with ocellate brown spots on sides, and a white-bled brown subdorsal band; dark brown head and black cervical shield; in the ins and between leaves of poplar.
estern Pennsylvania.

IV. *Fore wing very narrow elongate-lanceolate;* M_1 *free from* R_5.

B. concors Meyrick. Head, with palpi, and abdomen whitish ochreous, nnæ and thorax somewhat darker; with tegulæ tinged with reddish. Fore g pale ochreous, suffused and sprinkled with fuscous, the third fourth of the a reddish brown, and apical part paler, more or less tinged with reddish; costal ge with three dark basal dots, apical fringe with a dark basal line and a dark le outwardly. Hind wing pale gray; fringe yellower. 16 mm. (Unknown to

ily.
arry Sound, Ontario.

14. *COSMOPTERYX* Hübner

ntennæ practically as long as fore wing. more slender than in the other species, quite smoothly scaled toward base. Scape as long as entire width of head, only a sixth as thick; without pecten; palpi as long as head and thorax, ed laterally, smooth, and very slender. Hind tibiæ with very little loose r. Fore wing subfalcate (fig. 185) with apex of membrane produced, almost ar; with a silver streak in the apical fringe. M_1 long-stalked with R_{4+5}, and ally M_2 also, lower discocellular, and m-cu strongly oblique; Cu_2 long and itudinal. Hind wing linear, with more or less rudimentary veins; R running pex, long-stalked with M_1; the cell open below them; fringe five times as wide nembrane, or more.
arva with strongly flattened head but otherwise fairly normal; forming a ch mine with a hole in it through which the frass is ejected.
. *delicatella* and *fernaldella* belong to the subgenus **Lienigia** Spuler, with eyes er and rounded, front less prominent, scape and palpi rather shorter, spurs ind tibia rather above than below its middle, and larva not always ejecting excrement. The larvæ are to be sought in rush-like marsh plants.

Key to the species

Fore wing with fine longitudinal white lines toward base.
2. Lines short, centering at one-fourth the length of the wing; ground dark brown.
3. Inner margin very narrowly white toward base.

4. Tip of antenna black.....5. *pulchrimel*
4. Tip of antenna white.....6. *magophi*
3. Inner margin not edged with white.
4. Outer silver fascia of two obliquely placed vertical bars
4. *gemmiferel*
4. Outer silver fascia oblique, continuous.....3. *clemensel*
2. Lines extending out to middle of wing; ground light brown.
3. Expanse usually under 8 mm.; apex of antenna white.....2. *delicatel*
3. Expanse usually full 10 mm.; apex of antenna black.....1. *fernaldel*
1. Fore wing with a double silver spot at one-fourth way out; but no lines.
7. *clandestinel*

1. **C. fernaldella** Walsingham. Light brown. Head and thorax with three fi white lines; antennæ outwardly dark, with the fourth and tenth segments fr apex white, and sometimes other isolated segments also. Fore wing with cos edge, at basal third, and dorsal edge, toward base, finely white; three white strea on disc, the first running from costa, well out from base, and the lower reachi middle of wing. A yellow fascia covering third fifth of wing, bounded on each si with two silvery bars; the upper, inner one followed by a black spot; the outer t separated by a longitudinal yellow streak, which becomes white outwardly, is edg with dark brown, and runs through the fringe to the extreme apex. 8–10 m (*floridanella* Beutenmuller, *nigripunctella* Busck.)

Southern States; New Jersey; Ottawa, Ontario.

2. **C. delicatella** Walsingham. Similar. Antennæ with last four segments whi and normally also the sixth and tenth from apex. Fore wing with yellow fas broader than in C. fernaldella; the upper anterior silver bar located farther towa the base; and the following black dot small, the yellow extending basally below t bar and touching the lower white streak. 8 mm.

Southern States, north to District of Columbia.

3. **C. clemensella** Stainton. Very similar to *C. gemmiferella;* ground of fore wi darker, orange fascia paler, less reddish, its bordering fascia pale golden rather th violet, the more apical one oblique and continuous. Antennæ with apex broad white, and a broad white area about three-fourths way out, sometimes interrupt by a couple of black rings.

Larva on Ipomœa.

Massachusetts to Virginia and western Pennsylvania; "New York" (Unit States National Museum).

4. **C. gemmiferella** Clemens. Antennæ with apical three or four segments whi then four black ones, and one or two narrow white bands. Fore wing and thor dark greenish brown; three longitudinal white lines on body; fore wing with th short white streaks at a fourth way out, the upper resting on the costa; and white on inner margin; a broad orange fascia rather beyond the middle, with large, oval, violet-silvery fascia before it, extending almost across the wing, and t separate spots beyond, the upper offset outward about its width and edged abo with white; all the silver spots partly edged with black; a long silvery streak apical fringe, starting from a silver-blue apical dot. 11 mm.

June and July. Larva a miner in Ipomœa.

New York to Texas. New York: Sea Cliff, Long Island (Busck).

C. hermodora Meyrick (Exotic Microlepidoptera ii, 282) must be closely simil but with one broad subapical band on the antennæ.

5. **C. pulchrimella** Chambers. Antennæ outwardly black, with fourth apical joi white, and a second group of two or three white rings at three-fourths its lengt Fore wing much like *C. gemmiferella*; inner margin very narrowly white at ba yellow band duller and shading into brown toward base, rarely chocolate brow silver fasciæ bluish, the outer one continuous, oblique, starting from a white cos streak; apical white streak not reaching halfway in to the apical blue dot. 8 m

une. Larva yellowish white with black head, and finely divided cervical shield, iner on richweed (Pilea), making several successive mines and twisting and mpling the leaves.
Minnesota to southern Ohio.

. **C. magophila** Meyrick. Similar to *C. pulchrimella*; apex of antenna white, n five black segments, and two narrow white bands; dorsal edge rather strongly ite; orange fascia rather pale, its silver outer boundary offset out on the costa. mm.
August.
North Carolina; southern Ohio. New York: Ithaca.

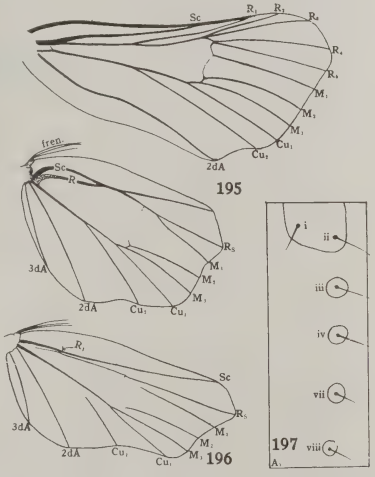
. **C. clandestinella** Busck. Antennæ blackish brown, last four joints white, then black and two or three white joints. Fore wing blackish brown, with two or ee short, longitudinally oval and usually confluent silver spots at basal fourth, nge area shortly and abruptly produced along costa, edged within by a narrow, nplete, violet-silvery fascia, followed by a band of the ground color. Outer silvery cia normal, its dorsal half stronger; streak in apical fringe small. 9 mm.
Late July. Larva a miner in grass (*Panicum clandestinum*), forming a clear, egular blotch, and ejecting the frass through a hole at the end. Light green th yellow head and cervical shield; at maturity developing three brilliant wine t longitudinal stripes. Cocoon made of a bit of epidermis folded lengthwise.
District of Columbia, etc.

15. *SYNALLAGMA* Busck

Palpus with third segment about half long as second and smoothly curved. ntenna with scape elongate. Fore wing nceolate, with apex drawn out into a rongly sickle-shaped hook, and the outer argin below it nearly erect. Eleven ins; R_1 lost, R_4 and R_5 stalked, running costa, M_1 free, ending at the apex, **2d A** rongly forked at base, **1st A** doubtful. ind wing half as wide as fore wing, nceolate; fringe twice as wide as membrane, with all veins preserved; **Sc** and **R** pproximate at base, **R** and M_1 connate, M_3 nd Cu_1 connate, M_2 free, with the cell open low it, Cu_2 well separated. Fore wing ith slight raised tufts. Maxillary palpi pparently absent. Hind tibiæ with short istles above.

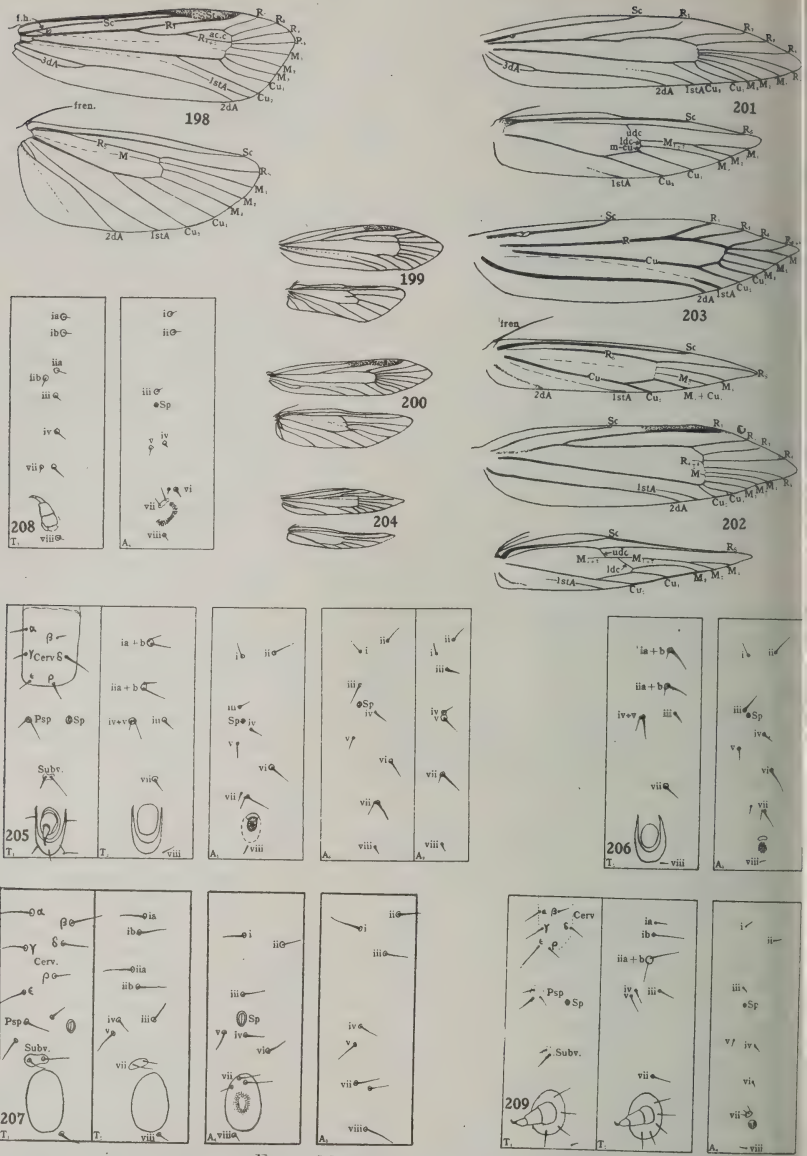
This genus is of very doubtful position; erhaps it is Heliodinid.

1. **S. busckiella** Engel. Dark brown. Antennæ annulate, dark and silvery gray; fore ing with coppery green iridescence; two ull white streaks in middle of wing, the pper one reaching the base; a double dark ilver spot beyond a silver bar across base f hook, with two white spots in costal inge near its end; apical fringe pale, fusous-tipped. Hind wing dark. 9–10 mm.
June to September.
Western Pennsylvania.



FIGS. 195–197. THYRIDIDÆ

195, *Dysodia oculatana*, venation; **196,** *Thyris maculata*, venation of hind wing; **197,** *Thyris fenestrella*, seta map of larva, ninth segment of abdomen (after Fracker)



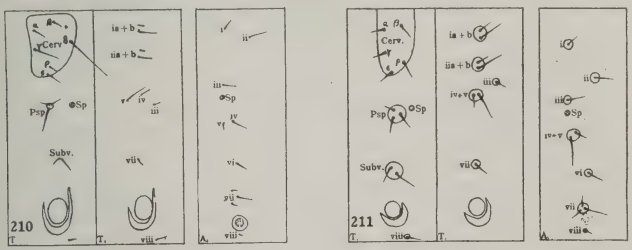
FIGS. 198–209. YPONOMEUTIDÆ

198, *Atteva aurea,* venation; **199,** *Yponomenta padellus,* venation (from a European specimen); **200,** *Plutella annulatella* (Europe), venation; **201,** *Plutella maculipennis,* venation; **202,** *Argyresthia oreasella,* venation; **203,** *Scythris cboracensis,* venation; **204,** *Epermenia illigerella* (Europe), venation; **205** *Yponomenta cagnagellus* (Europe), seta map of larva; **206,** *Swammerdamia* species (Europe), seta map; **207,** *Atteva aurea,* seta may after Fracker); **208** *Micza* species (Georgia), seta map; **209,** *Plutella porrectella,* seta map (from a European specimen).

SUPERFAMILY **YPONOMEUTOIDEA**

Head smooth, or nearly so, with a more or less distinct tuft on the rtex in Argyresthia, Zelleria, and Acrolepia, but with shorter vesti- re than in any of the true Tineidæ. Eyes moderate or small; ocelli ually present and often conspicuous; antennæ with pecten in some ses, without eye-cap, the scape of moderate size, as a rule; shaft th two rows of scales to each segment, the more basal always and the ner sometimes interrupted ventrally, varying from the condition of the ver Tineids to that of the Macrolepidoptera. Palpi normally upturned inute and drooping only in Heliodines) with third joint nearly as ng as second, smooth scaled, long and conical or fusiform, never ooping; second joint smooth-scaled or with various ventral tuftings, t never with the roughly triangular vestiture usual in the Tortricidæ; thout bristles. Maxillary palpi typically moderate and porrect, ther bristle-like, often minute, folded in Acrolepia. Tongue normally aled, often strong, very rarely absent. Hind tibiæ various. No uleæ or ovipositor. Fore wing with R_5 running to outer margin xcept in the Heliodinidæ), but doubtful in some genera with reduced nation; R_4 and R_5 usually separate; **1st A** free, usually distinct ward margin; **2d A** usually forked at base; hind wing with **Sc** and **R** osely parallel at base, usually connected by R_1, but sometimes sepa- te; never anastomosing. Female with two bristles in frenulum. enation complete or nearly so.

Larvæ and pupæ various, though always showing the three prespira- ular setæ in the larva. Cocoon very frequently lacelike of open meshes.



FIGS. 210–211. YPONOMEUTIDÆ

210, *Argyresthia nitidella* (Europe), seta map; **211,** *Epermenia illigerella* Europe), seta map

This superfamily, as here delimited, is a rather heterogeneous series f forms which do not definitely belong to any of the other recognized roups; and the family separation here given is largely arbitrary

(aside from the Ægeriidæ); but I believe it represents natural poin of division. The whole series of isolated genera has been put he in the Yponomeutidæ; some of them are nearly Heliodinid while othe would go as well in the neighborhood of the Tineidæ.

Key to genera of Yponomeutoidea (*except* Ægeriidæ)[24]

1. Venation complete or nearly so.
2. Fore wing with five radials preserved, all running to costa (fig. 219).
3. Wings lanceolate, hind wing immaculate ..... H 1. **Euclemens**
3. Wings linear; hind wing banded ..... H 4. **Idiogloss**
3. Wings linear, hind wing immaculate ..... H 3. **Erinec**
2. Fore wing with only four radials running to costa.
3. Hind wing with M_1 and M_2 long-stalked (fig. 201).
4. Palpi with a triangular tuft on second joint; maxillary palpi porrect a often large ..... Y 6. **Plutel**
4. Palpi nearly smooth.
5. Head with a few erect hairs behind; maxillary palpi folded. Y 9. **Acrolep**
5. Head with a large tuft on vertex; maxillary palpi obsolete. Y 10. **Argyresthi**
3. Hind wing with M_1 and M_2 separate; or a vein wholly lost.
4. R_1 arising beyond middle of cell, which is lanceolate; without accesso cell ..... Y 12. **Scythr**
4. Cell ample, with large accessory cell; R_1 almost always arising befo middle of cell.
5. Palpi very short, drooping (fig. 222); hind wing lanceolate; M_3 lon stalked or united with Cu_1 (fig. 218) ..... H 2. **Heliodine**
5. Palpi upturned at least at middle of front; or wings ample, usual both.
6. Hind wing with complete venation (6 veins arising from cell).
7. With M_3 and Cu_1 separate or connate.
8. Vestiture hairy; palpi obsolete ..... (Psychidæ-**Solenobia**
8. Vestiture mostly scaly, palpi well developed.
9. Hind tibiæ bristled.
10. Hind tibiæ bristled both above and below; **R** of hind wi ending at or above apex (fig. 204) ..... Y 8. **Epermeni**
10. Hind tibiæ bristled above only; **R** running to outer marg (fig. 220) ..... H 6. **Schreckensteini**
9. Hind tibiæ with long loose hair.
10. Palpi short, hardly exceeding front ..... Y 5. **Urodu**
10. Palpi upturned to vertex ..... (Xyloryctidæ-**Stenoma**
9. Hind tibiæ smooth-scaled.
10. Palpi nearly smooth.
11. Hind wing with M_3 and Cu_1 separate (fig. 198); fring less than half as wide as membrane; ocelli small. Y 4. **Atte**
11. Hind wing with M_3 and Cu_1 approximate (fig. 214); ocel very large.
12. Palpi with second and third joints equal (brown). G 4. **Glyphipteryx**

[24] In this key the letters prefixed to the genus numbers indicate the families: Y = Yponomeutidæ; G = Glyphipterygidæ; H = Heliodinidæ.

12. Palpi with third joint as long as first two together (steel blue).....G 1. **Abrenthia.**
10. Palpus with a triangular tuft; hind wing with **R** and $\mathbf{M}_1$ stalked .....Y 7. **Cerostoma.**
7. $\mathbf{M}_3$ and $\mathbf{Cu}_1$ stalked; ocelli present.
8. **R** and $\mathbf{M}_1$ parallel (figs. 214, 215).
9. Hind wing oblong, only about half as wide as fore wing. G 4. **Glyphipteryx.**
9. Hind wing broader and rounded or triangular; nearly as wide as fore wing (fig. 213).
10. Second joint of palpus with long hair below (fig. 216). G 3. **Choreutis § Millieria.**
10. Palpus smooth or somewhat rough.
11. $\mathbf{R}_4$ and $\mathbf{R}_5$ of fore wing stalked halfway to apex (fig. 242).....G 2. **Simaëthis § Allononyma.**
11. $\mathbf{R}_4$ and $\mathbf{R}_5$ separate.
12. Palpus with blunt truncate apex. G 2. **Simaëthis,** typical.
12. Palpus with acute apex..G 2. **Simaëthis § Brenthia.**
8. **R** and $\mathbf{M}_1$ of hind wing stalked.....(Xyloryctidæ, **Setiostoma**).
6. Hind wing with a vein lost.
7. Hind wing ample, with broadly rounded apex.
8. Ocelli large and conspicuous.....G 3. **Choreutis,** typical.
8. No ocelli.
9. Palpi smooth-scaled; (ground white or gray).
10. Fore wing with all veins preserved (fig. 199).
11. A transparent spot at base of **Cu** of hind wing. Y 2. **Yponomeuta.**
11. No transparent spot.....Y 1. **Prays.**
10. Fore wing with one vein lost.....Y 3. **Swammerdamia.**
9. Palpi very rough; (two-thirds of fore wing black). (Psychidæ, **Kearfottia**).
7. Hind wing lanceolate; ocelli present but not always large (fig. 215).
8. Apex rounded; palpi smooth.....G 4. **Glyphipteryx.**
8. Apex of membrane falcate; palpi rough, ending in a loose, truncate tuft .....Y 11. **Zelleria.**
1. Wings linear with three or four obscure veins (fig. 221); palpi with terminal bristles .....H 5. **Cyclopiasis.**

Family 24. YPONOMEUTIDÆ

(With *Plutellidæ, Argyresthiidæ, Acrolepiidæ, Scythrididæ,* etc.)

Head smooth, except sometimes on vertex; ocelli small or absent; antennæ moderate, without eye-cap; scape moderate; each segment of shaft with two rows of scales, of which the outer is usually a complete whorl; the inner interrupted more or less broadly below, exposing an area of sensory setæ (in Argyresthia with both whorls complete as in some Tineidæ; in some specialized genera with both interrupted, and the sensory area continuous; as in Scythris etc.); but with the outer row always distinctly better developed than the inner, and the inner always present and well-exposed dorsally. Maxillary palpi various;

labials moderate to long, upturned, without bristles, with the third joint long, and smoothly scaled; almost always straight and fusiform; tongue present, sometimes naked. Eyes good-sized. Thorax with scaly vestiture; legs various, typically smooth-scaled. Venation but little reduced; fore wing with $\mathbf{R}_5$ running to outer margin; usually with all veins separate, and usually with a stigma along costa from tip of **Sc** to $\mathbf{R}_1$; hind wing with **R** and $\mathbf{M}_1$ well separated, except in Cerostoma; $\mathbf{M}_1$ and $\mathbf{M}_2$ often stalked; **1st A** distinct in both wings.

Larva quite variable (figs. 205–211) but always with seta *beta* on the cervical shield farther from the middle line than *alpha,* setæ **iv** and **v** widely separated on the abdomen, and the prespiracular wart bearing three setæ.

Egg, so far as known, of flat type and normal. Pupa obtect; with maxillary palpi distinctly preserved; with pilifers represented by distinct lobes only in the genus Atteva; front femora exposed except in Scythris. The pupæ are less heterogeneous, apparently, than the larvæ, except for Scythris and Atteva.

The family as here limited is far from homogeneous: Yponomeuta, Prays, and Swammerdamia form the Yponomeutinæ, and are close relatives; Plutella, Cerostoma, and Trachoma form a second group: Plutellinæ; and Argyresthia and Zelleria, a third. The remaining genera are entirely isolated. Acrolepia partly fills the little gap between Argyresthia and the Tineidæ; Atteva is a fair Pyralid in the pupa, though nearly a normal Yponomeutid in the adult, and with several exotic genera may constitute the transition from the Tineids to the Pyraloids and Macros. Scythris shows characters of the Gelechioidea, and may not belong here; Epermenia seems to belong in this region but is generically isolated.

Besides our miscellaneous assortment, several other types occur in Europe and in the tropics, some of the latter hardly to be distinguished from the Zygænidæ, and others connecting the Ægeriidæ and Heliodinidæ with this family (Tinægeriidæ). The Tinægeriidæ, as usually delimited, are mostly placed by Meyrick in the Heliodinidæ.

1. *PRAYS* Hübner

(*Yponomeuta,* in part)

Similar to Yponomeuta, but with fully scaled wings. $\mathbf{R}_1$ and $\mathbf{R}_5$ of the fore wing typically stalked, and basal fork of **A** very large; our species with the venation of Yponomeuta, $\mathbf{R}_4$ and $\mathbf{R}_5$ being either stalked or closely approximated.

1. **P. atomocella** Dyar. Much like *Y. multipunctella,* black dots larger; abdomen, fringe, and hind wing dull salmon color, duller in male. 20 mm. (*diaphorus* Walsingham; *Yponomeuta* Walsingham and Dyar.)

April. Larva on Ptelea.

Southern Ohio; Illinois; Texas.

2. *YPONOMEUTA* Latreille

(*Hyponomeuta*)

Vestiture of head, body, palpi, and hind tibiæ entirely smooth, that on the head being of even, fine hair. No ocelli; male antennæ with the outer rows of scales raised, the sensory areas good-sized; scape large, cylindrical, with pecten; palpi reaching about to middle of front, slender, often drooping; maxillary palpi minute. Metathorax very large; scutum undivided. Fore wings (fig. 199) broadest four-fifths way out; with rounded, nearly erect outer margin, and well-marked anal angle at Cu_1; accessory cell large; M_3 and Cu_1 arising rather close together, the other veins well spaced out. Hind wing about as broad as fore wing; oblong, with a transparent spot at base of **Cu**; M_3 lost; the other veins well separated.

Larvæ (fig. 205) social, in a loose web. With primary setæ only; posterior dorsal setæ on cervical shield farther apart than the anterior ones; **ia** and **b** obliquely placed on metathorax; **iv** and **v** widely separate on abdomen; prolegs with several complete circles of hooks. Pupa without fronto-clypeal suture; with prothorax much narrowed on middle line; antennæ shortish, and not meeting on middle line; maxillary palpi large, touching antennæ, middle legs, and tongue-case; abdominal spiracles produced and tubular, but not the thoracic ones; cremaster represented by four divergent setæ.

1. **Y. multipunctella** Clemens. White. A black spot on collar and a few on thorax; fore wing with rows of black spots, those on **A** and above fold quite regular. Male with hind wing gray except toward inner margin, base of costa, and under side; female with ground color wholly white; fringes all white; in aberration **leucothorax** Meyrick without dots on thorax. 20 mm. (*orbimaculella* Chambers, *euonymella* Chambers, *ordinatellus* Walker, ♂ *semialba* Meyrick (**H 48**:44).

Larva social on Euonymus.

Y. leucothorax Meyrick was described as a male with white hind wing.

General but local in distribution. New York (Edwards and Angus Collections).

2. **Y. padella** Linnæus, with fore wing lightly suffused with gray, or at least with a pale gray fringe, and wholly darker gray hind wing in both sexes, has been introduced at Rochester, Geneva, and Scholarie, New York, and is somewhat injurious to apple and other trees of the Rosaceæ.

3. *SWAMMERDAMIA* Hübner

Closely related to Yponomeuta; palpi short, projecting, rough, not unlike Argyresthia; no maxillary palpi; head slightly roughened, but less so than in Argyresthia. Wings narrower than Yponomeuta and more lanceolate, but with the same translucent patch. Larva (of European species, fig. 206) much like Yponomeuta, with seta **ib** behind **ia** on metathorax, and the anterior seta of the prespiracular wart lower (instead of higher) than the other two.

1. **S. castaneæ** Busck. Head and thorax cream-white, becoming gray behind; fore wing shining violet gray, heavily dusted on a luteous ground, leaving the costal fringe mostly pale, and pale striæ on the inner margin; wings becoming strongly coppery toward the apex. 12 mm. (*pyrella* Busck, not Villiers).

Larva solitary, in a loose open web on upper side of chestnut leaves. Green, shaded with darker; tubercles very dark in pale yellowish areas; **i** and **ii** in line, forming a broken subdorsal band. Head yellowish; cervical shield pale. Early July. Cocoon white, spindle-shaped, suspended in web. Moth emerging in August.

Dublin, New Hampshire; Connecticut; Pennsylvania.

There is a closely related, undescribed, oak-feeding species, with only a white bar in the fringe and the thorax wholly white.

4. *ATTEVA* Walker

(*Œta* Grote; *Pœciloptera* Clemens)

Palpi closely upturned to vertex, and smooth-scaled; ocelli absent; tongue strong, naked; maxillary palpi obsolete; antennæ smoothly scaled, with short segments. Wing form much like that of Yponomeuta (fig. 198); the hind wing more or less translucent at the base, more ample than usual. All veins present and well separated. Hind tibiæ smooth in female, hairy in male.

Larvæ (fig. 207) social in a web on Simarubaceæ; much like those of Yponomeuta, but with two setæ instead of one on the leg-base of the mesothorax. Pupa aberrant, Pyraloid, with strong lobes representing pilifers, meeting in the middle line, so as to leave a suture running forward from the base of the tongue; labial and maxillary palpi almost completely covered; antennæ reaching tip of wing, separated by hind legs and tongue; frontoclypeal suture partly preserved, but epicranial suture absent; seventh segment of abdomen free in male, but no deep suture between ninth and tenth segments.

Atteva is a tropical genus of both hemispheres; our species was probably introduced from South America. It has been put in various groups, and even made the type of a family, Attevidæ.

1. **A. punctella** Cramer. Fore wing with alternate pale yellow and bright orange, rarely brown, bands; the yellow bands wider and cut into rounded spots by a fine black network. Hind wings translucent, smoky. 25–30 mm. (*aurea* Grote). (**H 48**:36.)

Larva social; in a web on Ailanthus.

New York to Illinois and south.

5. *URODUS* Herrich–Schæffer

(*Trichostibas* Zeller)

Antennæ without pecten, no ocellus; eyes very large; front strongly tapering below, the palpi hardly extending beyond it; tongue weak. Hind tibiæ with some loose hairs above, at base. Fore wing narrow, oblong; costa arched, apex bluntly rounded. All the veins preserved and free; R_5 running to apex; accessory cell cutting off the upper angle of the discal cell obliquely; with R_2 arising from beyond its middle, Cu_1 and Cu_2 somwhat approximate and strongly curved at base, starting off from the Cu-stem at right angles; **2d A** forked. Hind wing ample, translucent; anal angle slightly lobed; all veins present and well separated; **Sc** and **R** parallel, not closely approximated. Cu_1 and Cu_2 curved and widely separated fro mthe rest. (**H 29**:66, as *Cydosia majuscula*).

The genus is a good sized one in South America, and looks more like a Pyromorphid than a Tineid.

1. **U. parvula** Henry Edwards. Blackish, immaculate. 20–25 mm. (*calligera* auct.)

Larva on Persea. With stiff bristles and yellow head. Cocoon oval, formed of regular, open trapezoidal meshes in oblique series; suspended by a thread which extends down along the side of the cocoon. The cast larval skin is ejected through a hole in the bottom; the pupa emerges through a similar hole in the top, before eclosion.

District of Columbia; Florida. The northern record is based on a single specimen which may have been a stray.

6. *PLUTELLA* Schranck

Head somewhat rough, but less so than in Argyresthia; ocelli present, small; maxillary palpi porrect, small in our species; labial palpi with a long triangular tuft on second segment; third smooth-scaled and sharply pointed, upturned; antennæ with pecten; more roughly scaled than in Yponomeuta; hind tibiæ smooth; wings broad-lanceolate, not distinctly falcate; M_1 and M_2 of hind wing approximate or fused on basal third (figs. 200, 201) (fused in our species), then separating; the other veins separate.

Larva (fig. 209) forming a slight web on Cruciferæ. Prolegs slender, with a single circle of hooks at the enlarged end; seta vii of metathorax single; abdomen with setæ iv and v remote. Pupa in a cocoon of regular, open meshes, which does not at all conceal it. Pupa similar to that of Yponomeuta, but with the thoracic spiracle tubular, as well as the others, the cremastral setæ hooked, and the tongue more than three-fourths the length of the wings.

1. **P. maculipennis** Curtis (The diamond-back moth.) Wings narrower and more lanceolate than *P. porrectella;* with M_1 and M_2 of hind wing fused two-thirds way to the margin. Fore wing of male with upper two-thirds mouse gray, lower third pale, the boundary usually marked by a darkening of the upper and a whitening of the lower ground color, with three sharply marked teeth. Female paler, without contrasts, but with the markings, so far as traceable, like those of the male. 13 mm. (*cruciferarum* Zeller; *xylostella* in part; male *limbipennella,* female *mollipedella* Clemens; female *dubiosella* Beutenmuller).

Caterpillar green with black head. On various Cruciferæ; often injurious to cabbage.

Generally distributed; probably introduced from Europe. New York: Ithaca, Albany, West Farms.

2. **P. porrectella** Linnæus. Wings broader; M_1 and M_2 fused only one-third way to margin; fore wing paler; luteous, with only traces of the diamond-back markings. Outer margin and fringe contrastingly blackish (*vigilaciella* Clemens). 14–15 mm.

Larva on the more slender Cruciferæ, such as Hesperis. Similar to *P. maculipennis,* but with brown head.

Europe; New Jersey; also on Pacific Coast. Probably introduced in the East.

7. *CEROSTOMA* Latreille

(With *Trachoma, Harpipteryx, Periclymenobius, Credemna,* etc.)

Similar to Plutella. Wings in our species falcate; R and M_1 of hind wing, and sometimes R_1 and R_5 of fore wing, stalked; M_1 free and well separated from M_2; palpi with triangular tuft decidedly larger, and third joint proportionately quite small, but of the same character. Of the numerous subgenera which have been formed, our *falciferella* belongs to Trachoma, with R_4 and R_5 separated, and *dentiferella* and *xylostella* to Harpipteryx (Periclymenobius), with R_4 and R_5 stalked.

Larva similar to that of Plutella, with the hooks of the prolegs in a single row.

1. **C. falciferella** Walsingham. Wings very long and narrow, of almost even width, with falcate tip and nearly erect outer margin. Powdery grayish brown with two darker parallel oblique shades. (*ordinatis* Meyrick.)

Larva to be expected on Rosaceæ. Moth in August.

Highlands of the Hudson, New Jersey; Ithaca, New York; Pacific States.

2. **C. dentiferella** Walsingham. Wings with extended falcate apex. Fore wing pinkish buff on costal two-thirds, pale yellow along inner margin; with a broken darker shade along the boundary, black in California specimens. Hind wing pale. (*frustella* Walsingham.)

Known from California; Douglas Lake, Michigan; and Ontario (where the pale form **canariella** has been taken in July).

3. **C. xylostella** Linnæus. Similar to *C. dentiferella* in structure. Fore wing very strongly falcate, dark brown, with inner margin contrastingly light yellow, its white edging sending a fine spur up to beyond end of cell. Hind wing dark brown. Head and top of thorax white.

June to July. Larva on Lonicera.

Hyde Park, Massachusetts (Haimbach). New York: Ithaca (W. T. M. F.).

8. *EPERMENIA* Hübner

(*Chauliodus* Treitschke)

Head smoothly scaled, rounded, without ocelli; antennæ a little over half as long as fore wing, with pecten; palpi upturned to middle of front or beyond, with the second joint slightly rough-scaled; the third joint similar and rather shorter, broadly scaled to the apex; maxillary palpi very small, folded across the tongue; tongue weak and naked. Hind tibiæ stiffly bristled above and below; spurs above middle; tarsi and mid-tibiæ also bristled. Wings lanceolate (fig. 204), more or less falcate, almost as in Cerostoma; fringe broad at anal angle and sometimes making the falcation much more marked. Fore wing with **Sc** reaching to middle of costa; R_1 arising from before middle of cell, twice as long as R_2; normal, with all veins present and well-marked accessory cell; R_4 and R_5 sometimes stalked, but separate in *imperialella*, forking over apex; with small scale-tufts in dorsal fringe. Hind wing with **Sc** reaching well toward apex, typically longer than **A** of fore wing, **R** and M_1 approximate at origin or stalked; the rest free; but the medials typically closely approximate; **m-cu** longish and parallel to outer margin; hind wing lanceolate, narrower than fore wing.

Egg rough, oval, horizontal. Larva (fig. 211) with setæ **iv** and **v** on a single large plate; prolegs with 16 hooks in a single circle; the anals with 12 hooks. Pupa perhaps the most primitive of the Obtectæ, with seventh segment of abdomen free in male, but third fixed; not progressing, with a large head and a narrow prothorax; a small maxillary palpus not reaching the tongue; and a specialized cremaster with about 10 hooked setæ; antennæ reaching to tip of wing but tongue falling short; two deep pits on sides of ninth segment of abdomen.

The genus is apparently of the same stock as the Yponomeutidæ, but is quite isolated and doubtful in position. Superficially it may be mistaken for Acrocercops, but differs in the tufted wing and more extensively spined legs, as well as in the family characters.

Key to the species

1. Yellow, fringe falcate, more decidedly so than membrane.....6. *imperialella.*
1. Grayish, membrane lanceolate, fringe less falcate.
   2. Base of wing not noticeably paler.
      3. A white discal dot, preceded by a heavy black bar.....1. *albapunctella.*
      3. No white discal dot; at most, with some whitish scales outlining a black dot.
         4. Ash gray with yellowish streaks.....2. *ramapoëlla.*
         4. Reddish with sparse, irregular, white dusting only.....3. *pimpinella.*
   2. Basal third somewhat paler gray.....4. *cicutaëlla.*
   2. Basal half whitish.....5. *canicinctella.*

I. *Fore wing with a series of about six tufts on inner margin; the first one the largest, and the last ones in the fringe;* R_1 *and* R_5 *stalked; hind wing linear, more acute, a fourth as wide as its fringe, with* M_1, M_2, *and* M_3 *approximate or stalked* (Epermenia).

1. **E. albapunctella** Busck. Blackish gray, irregularly powdered with grayish white; two white dots on disc, the outer one contrasting; a thick black bar between them, which spreads out into a transverse bar at its anterior end. 12 mm.

Early spring.

Oak Station (Alleghany County), Pennsylvania.

2. **E. ramapoëlla** Kearfott. Palpi gray, dark-dusted on outer side, as usual; head paler. Fore wing somewhat streaked with luteous; black points at middle and at end of cell, more or less defined with pale yellow, and a slight dark oblique streak running up from inner margin to beyond the more basal black point. Wing outwardly blackish-dusted; the apical fringe quite dark gray. 13 mm.

Lighter than *E. pimpinella* and larger, shaded with luteous instead of the peculiar reddish gray of *E. pimpinella*.

Ramapo, New York (type).

3. **E. pimpinella** Murtfeldt. Powdery reddish gray; becoming almost chocolate brown on costal half; with a couple of unpowdered areas on the middle of the wing; sometimes with these areas extended, leaving the powdery ground only on the inner margin toward the base and an irregular, dominantly white, apical area and costal fringe. Three ocellate discal dots in a series. Five or six blackish tufts on the dorsal margin, regularly increasing in size toward the base. 9 mm.

Bred from Umbelliferæ.

Missouri.

4. **E. cicutaëlla** Kearfott. Ground luteous; basal third of fore wing largely so, but lightly strigose with black; outer two-thirds a mixture of brown, luteous, and black, the brown mostly in the middle of the wing. Dark specimens showing the brown more generally, especially toward base of costa. Base usually contrastingly pale to the naked eye, its outer boundary aligning with the largest dorsal tuft. Two longitudinal, barlike, ocellate discal dots.

Larva in flowers and seeds of Cicuta (Umbelliferæ).

New Jersey.

5. **E. canicinctella** Clemens. Basal half of fore wing whitish; outer half fuscous; the boundary slightly oblique outwardly; a postmedial, slightly irregular, whitish band, better-defined on the outer side, followed by a raised black spot toward inner margin. Fringe broad without tufts in it.

I have seen only the unique type of this species; it probably does not belong here, but to the Lavernidæ (possibly to the genus Blastodacna).

II. *Fore wing with only one really distinct scale tuft on inner margin; antennæ heavily pubescent, with reduced scaling; hind wing broad-lanceolate, with blunt apex; fringe only twice as wide as membrane,* M_1, M_2, *and* M_3 *separate.* R *short-stalked. Fore wing with* R_4 *and* R_5 *separate.*

6. **E. imperialella** Busck. Straw yellow. Thorax and head darker; palpi fuscous on outer side. Fore wing with a broad, oblique, ochreous shade extending from a third way out on inner margin to middle of costa; some less oblique streaks before apex and a more or less double blackish line in fringe beyond anal angle. Hind wing pale gray with yellower fringe. 15 mm.

June.

Western Pennsylvania.

9. *ACROLEPIA* Curtis

Head moderately rough above; with ocelli; palpi upturned about to vertex, slightly tapering, the end joint long; maxillary palpi apparently rather longer than eye, slender, folded. Hind tibiæ smooth-scaled. Venation as in Argyresthia; accessory cell strongly marked; our species with fore wing a little falcate; Sc long; hind wing rather trapezoidal, nearly as wide as fore wing; M_1 and M_2, M_3 and Cu_1 stalked. Early stages not studied structurally.

The genus is sometimes put in the family Tineidæ or Argyresthiidæ, sometimes in the Yponomeutidæ or Plutellidæ, and sometimes given family rank. It seems

a little lower than Argyresthia but closely related to it. The wing-form makes it look like a minute Cerostoma.

1. **A. incertella** Clemens. Fore wing gray-brown, somewhat iridescent with red bronze; with vague darker streaks and patches, especially one at middle of costa; an oblique white streak extending up from inner margin near base, to about middle of wing; hind wing pale. 12 mm. (*Adela flamensella* Dietz, not *flammeusella* Chambers).

April; July and August; October. Larva tying and skeletonizing leaves of smilax, or boring in bulbs of Lilium. Pupa in a lace cocoon, like those of the rest of this series.

New Hampshire to Kentucky; west to California.

10. *ARGYRESTHIA* Hübner

(With *Blastotere* Ratzeburg)

Vertex rough-hairy, though less so than that of Tinea; front smooth-scaled; no ocelli; antennæ normal; the shaft with two nearly complete circles of scales to a segment; pecten strong, sometimes almost an eye-cap. Labial palpi moderate and porrect, or upturned nearly to vertex, smooth-scaled or a little roughened; maxillary palpi obsolete; hind tibiæ with spurs near middle, usually rather sharp edged above, with some rough, bristly hair, which may also extend on the metatarsus, but otherwise smooth-scaled. Fore wing lanceolate (fig. 202), with **Sc** short, R_1 arising from middle of cell or before; R_4 and R_5 typically free (stalked in group **Blastotere**); M_2 and M_3 free, stalked or rarely united (*annettella, rileiella*); accessory cell and usually base of **M** distinct; **1st A** distinct; **2d A** shortly forked at base, long; a stigma on costa before R_1, as in many Yponomeutidæ; hind wing with costal cell abruptly narrowing before the middle; **Sc** ending at middle of wing or before; M_1 and M_2 stalked, widely separate from **R**; M_3 and Cu_1 free, stalked, or, in one western species, united; hind wing lanceolate, narrower than fore wing. The imago differs from the typical Tineidæ mainly in the lack of palpal bristles, and in the fact that R_5 runs to outer margin, in both of which points it agrees with the Acrolophinæ.

The larvæ (fig. 210) bore in twigs, buds, and fruits, or occasionally are leaf-miners; the cocoon is of white silk, often spun in the tunnel. The pupa is obtect, with maxillary palpus reaching from antenna to the maxilla, which is extended laterally to meet it; middle leg not reaching maxillary palpus; tongue short; antennæ reaching to tip of wings; cremaster unspecialized, with eight hooks and setæ.

The moths of this genus rest with the head appressed to the substratum, and the tail held up at a sharp angle.

Key to the species

1. Fore wing silvery and golden or bronze brown.
2. With definite markings.
3. Ground wholly golden, with brown markings; head white..10. *alternatella*.
3. Part of ground, at least, white.
4. Disc of thorax golden; head more or less yellowish; fore wing silver with golden fasciæ.....1. *gædartella*.
4. Head and thorax white.
5. Markings outlined with dark brown; median fascia broader on inner margin, rarely reaching costa.....3. *oreasella*.
5. Markings black-brown on silver.....4. *media*.

5. Markings golden, not outlined.
6. Apical marks of three or four confused striæ; or suffused with golden.
7. With a black apical spot; sometimes a single scale.
8. The golden area dominant; markings slightly diffuse. 6. *freyella.*
8. White ground color predominant; markings clean-cut.
9. A forked median fascia.....7. *annettella.*
9. No forked median fascia.....8. *apicimaculella.*
7. No black apical spot.
8. Dorsal margin white.
9. Inner margin narrowly white, with dark spots. 13. *belangerella.*
9. Inner half of wing white.
10. No dorsal dark spot.....9. *subreticulata.*
10. A dorsal spot or dot near middle of inner margin. 11. *castaneella.*
8. Dorsal half barred with silver, white, and golden. 5. *pygmæella.*
6. Apical marks simple, enclosing only three silver spots. 2. *calliphanes.*
2. Immaculate pale golden.....12. *laricella.*
1. Not metallic; markings brown or blackish.
2. Expanse 12 mm; white dorsal area narrow, not extending up to fold toward base.
3. Spot on middle of inner margin rounded, separate.....13. *belangerella.*
3. Spot on middle of inner margin, broadly connected to dark costal region. 14. *conjugella.*
2. Expanse 9 mm.; white dorsal area often covering half of wing.
3. Ground color of fore wing light brown except basal half of inner margin. 15. *rileiella.*
3. Ground color white, more or less marked with black-brown.
4. A complete oblique transverse fascia.
5. A large, dark streak preceding the fascia.....17. *austerella.*
5. At most, a small dot preceding the fascia.....16. *undulatella.*
4. Median fascia broken below costa.....18. *thuiella.*

I. *Fore wing with metallic markings.*

*R_4 and R_5 *free; apical markings coarse* (Argyresthia).

1. A. gœdartella Linnæus. Thorax bright golden; fore wing white and coppery golden; first band running from costa at base to a quarter way out on inner margin; median band a widely forking upright Y; outer band similar, but inverted and sometimes joining the dark terminal patch. 11–13 mm.

April; June to August. Larva green or reddish, with dark brown head and cervical shield marked with black; in catkins and under bark of twigs of birch and alder.

Europe; reported from various places in United States, in part, at least, in error for *A. calliphanes.*

2. A. calliphanes Meyrick. Head white; thorax white, slightly gray-stained; wing markings exactly like those of *A. gœdartella*, but on the average slightly more extensive.

Larva on alder.

Toronto, Ontario, and Maine, to British Columbia and California. New York: Albany.

3. **A. oreasella** Clemens. Head and thorax white; fore wing silvery; marks golden, edged with brown, except the yellow shade at base of costa. Median band a half-crescent, somewhat irregular and rarely reaching costa; sometimes with two small dots opposite it on costa; outer third with an irregularly forked golden figure, enclosing four white spots, of which the one two-thirds of the way out on the costa is the largest; or with the three outer spots fused into one. 10–13 mm. (*andereggiella* of American authors).

July. Larva possibly on oak.

Distribution general. New York: Wells, Rock City (Cattaraugus County), Ithaca, Poughkeepsie, West Farms.

4. **A. media** Braun. Silver; palpi, face, and front of tuft pale golden; antennæ annulate golden and pale brown, rather less contrastingly than in *A. oreasella;* tegulæ golden. Fore wing with costal edge suffused with pale golden; markings dark bronzy brown; a rather broad fascia from middle of dorsum almost to costa, widening upward, with a spur running obliquely outward to join the eleventh or twelfth of a series of dark costal striæ; apical third dark bronzy, extended inward acutely toward middle of wing and enclosing two white costal spots and three smaller dorsal ones. 9 mm.

This species is transitional to the following group.

Late May.

Cincinnati, Ohio.

5. **A. pygmæella** Hübner. Silver white, slightly yellowish; antennæ annulate; tegulæ golden; fore wing with golden fasciæ fading out above, the first one meeting a dash in the base of the fold, connected by suffusion to the base of the costa; the second fascia outwardly oblique and fading out at costa; the third confused and running out into the mottled apex. Costal region lightly strigose with golden. 12–14 mm.

July.

Ottawa, Ontario, to British Columbia; Europe.

If the American form is distinct, its name will be *chalcochrysa* Meyrick.

**R_4 *and* R_5 *stalked in fore wing; with fine apical striæ.*

6. **A. freyella** Walsingham. Golden yellow and silvery white. Base of the fore wing streaked, the rest marbled, tending to form wavy anastomosing transverse bands; tegulæ golden; antennæ annulate. 8 mm. (*abdominalis* Zeller, in part, *thuiella* auct., not Packard.)

June. Larva on red cedar and arbor vitæ.

Ottawa, Ontario, to New Jersey and Texas. New York: Ithaca (United States National Museum).

7. **A. annettella** Busck. Tegulæ white; fore wing silvery white; a golden antemedial band; costa golden from it to base; a median band, wider on costa and enclosing a small white spot; the outer third with about three broken golden striæ. 9 mm.

June and July. The larva mines about four leaves at the tip of a juniper twig, passing through the stem from leaf to leaf, completely emptying the leaves, and scattering the frass. It hibernates in the mine; it pupates in May, in a cocoon of open meshes, formed outside the mine.

Connecticut to southern Ohio.

8. **A. apicimaculella** Chambers. Silvery white; fore wing with a more or less triangular dark brown apical spot, and with indistinct brownish streaks across the apex before it; a bright ochreous streak below base of costa, or suffusion on costa. 9 mm.

July. Larva possibly on oak.

New Jersey to western Pennsylvania and Kentucky.

9. **A. subreticulata** Walsingham. Costal third light bronzy brown, outwardly reticulate on a white base; the rest of the wing pure white. 9 mm.

June. Larva on red maple.

New Jersey to Pennsylvania.

10. **A. alternatella** Kearfott. Head white; palpi golden; antennæ golden fuscous; scape paler; thorax white; posterior part and tegulæ golden. Fore wing golden ochreous, with oblique and anastomosing brown fasciæ, terminating in five evenly spaced costal and three dorsal patches. Fringe yellowish toward apex; fuscous at anal angle. 10–12 mm.

May; July. Bred from juniper berries.

Essex County, New Jersey. New York: Ithaca.

11. **A. castaneella** Busck. Near *A. subreticulata;* antennæ annulate, golden and brown; base of tegulæ pale golden; fore wing with costal edge golden, gradually widening beyond middle into the golden brown apical region, which is slightly reticulate with white. A golden brown spot at end of cell and one on middle of inner margin.

May and June. Bred from bark of chestnut infested with Sesia.

New Hampshire; Virginia.

12. **A. laricella** Kearfott. Head and palpi whitish ochreous; second segment of palpi somewhat fuscous toward tip; face, antennæ, and thorax white, the latter yellowish. Fore wing very pale shining ochreous, the basal half of the costal edge and fold narrowly darker.

Larva in terminal twigs of *Larix americana*, forming a burrow sometimes 15 cm. long; in injurious numbers at the Mer Bleue, near Ottawa, Ontario. Moth in July.

II. *Without metallic lustre.*

*R_4 *and* R_5 *free.*

13. **A. belangerella** Chambers. Head and thorax white, with brown tegulæ; costal half of fore wing brown, the costal edge with darker dots, alternating with whitish ones. Dorsal third white, interrupted by a couple of dark spots. 13 mm.

The type shows considerable gloss and might possibly be put in the first group of the genus.

June.

Canada (Montreal and Ottawa).

14. **A. conjugella** Zeller. Closely similar to *A. belangerella*, but with the blackish spot near the middle of the inner margin squarish and broadly connected with the brown general surface of the wing. 12–13 mm.

July. Larva on fruit of apple and mountain ash.

New York to British Columbia; Europe. New York: Mt. Marcy (3000 feet), Trenton Falls.

A. belangerella may be only a variety of this species.

15. **A. rileiella** Busck. Light brown, somewhat shining; head and thorax, except tegulæ, white; dorsal margin on basal half white, at middle cut by a heavy brown bar, and outwardly more or less striated; apex striated as in *freyella* and its relatives, but less strikingly. No black apical dot. 9 mm. (*mendica* Walsingham, not Haworth).

This species may possibly be a dwarf form of *A. conjugella.*

District of Columbia.

** R_4 *and* R_5 *stalked* (Blastotere).

16. **A. undulatella** Chambers. White; antennæ annulate with black and white. Fore wing dusted with dull brown except on inner margin; base white except at costal edge, forming a white triangular area. An oblique, slightly irregular, dark median fascia, weaker at margins, and an apical patch formed of three partly fused fasciæ. 8 mm.

Larva a bast miner on trunks and larger branches of elm; maturing early in the spring. Cocoon on the bark. Moth in June; sometimes abundant.

Massachusetts to Kentucky and Missouri.

The stalking of R_4 and R_5 in this species is inconstant, in fact the Cornell University collection has a specimen in which R_4 and R_5 are stalked on one side only. Meyrick has based the name **mesocausta** on specimens in which R_4 and R_5 are separate. This appears to be the more usual condition.

17. **A. austerella** Zeller. White, with four, parallel, oblique, slightly irregular, dark fasciæ; the first usually not reaching the inner margin, the second complete, the third and fourth near the apex, obscurely forked at costa and lying in a fuscous-dusted area. Some brown also on base of costa. Fringe dirty white. 9 mm.

June.

Maryland to North Carolina, and Kansas to Texas. New York: Otto, Rock City (Cattaraugus County).

18. **A. thuiella** Packard. Similar to *A. undulatella;* the median band not so black, and broken into costal and dorsal spots, not oblique; an erect postmedial band. Oblique apical striation grayer, best-marked on the costa. 8 mm.

June. Sometimes injurious to arborvitæ, eating out the tips of the shoots.

Canada and Maine to Pennsylvania. New York: Ithaca, Hicksville, Westerly, Long Island.

11. *ZELLERIA* Stainton

Much like Argyresthia. Ocelli present; third joint of palpi broadly scaled, somewhat blade-like in *Z. celastrusella;* vestiture spreading in *Z. retiniella* and *haimbachi*, the second joint also quite rough scaled; venation as in Argyesthia; **Sc** of hind wing short; M_3 wanting, M_2 free.

In *Z. celastrusella* the palpi are very rough and the wing has rough scales and tufts as in Xyrosaris Meyrick, but in the latter the antenna is as long as the fore wing, in our species much shorter. Neither of our species is typical of the genus.

1. **Z. celastrusella** Kearfott. Grayish, powdered with brown on a pale gray base; the wings loosely scaled and with scattered black dots formed of a single long scale each; head paler; palpi pale in front. Fore wing with a dark fascia at a fourth way from the base; white patches well toward the apex, and opposite each other on costa and on dorsal margin. Terminal line black, fringe dark. A long pencil of dark hair arising from base and extending along the under side of costa. 13–16 mm. (*Xyrosaris* Meyrick.)

End of May to June. Larva vivid green, cervical shield concolorous, shining; head olive; legs yellower. Webbing leaves together and feeding in terminal twigs of *Celastrus scandens*, in early spring. Moth resting with the head appressed to the substratum and tail raised, as in Argyresthia.

New Jersey; New York (Kearfott); Texas.

2. **Z. haimbachi** Busck. M_2 of hind wing distinctly nearer Cu_1 than M_1. Wings smooth. Palpi ending in a large loose tuft of spatulate scales. Yellow ochre; head white; a broad, somewhat diffuse, white longitudinal band through fore wing. Hind wing pearl gray. 10 mm.

July. Larva on short-needle pine, in June.

Wenonah, New Jersey.

3. **Z. retiniella** Kearfott. Structure much as in *Z. haimbachi.* Antennæ much shorter than fore wing. Fore wing bright golden, with confused white striæ on the disc, the striæ formed of scales some of which have yellow-brown and light gray-brown spots and bars. Fringe white, gray-brown at apex. Hind wing white, gray-brown at apex, with white fringe. Head and thorax white, tegulæ golden. 15 mm.

July 4.

Lakehurst, New Jersey.

12. *SCYTHRIS* Hübner

(*Butalis* Treitschke; *Arotrura* Walsingham)

Head smoothly scaled; eyes small, ocelli and pecten variable, the latter typically present, but absent in our species (group **Apostibes** Walsingham). Palpi smoothly scaled, upturned about to vertex, or somewhat shorter, maxillary palpi extremely small and folded over base of tongue, as in the Gelechioidea. Shaft of antenna much as in Yponomeuta; scaled dorsally only; with strong bristles on sensory area; hind tibia hairy. Body stout. Fore wing lanceolate (fig. 203); R_1 arising from well beyond middle of cell and short; cell narrow; without accessory cell; R_4 and R_5 more or less stalked, forking over apex; R_5 running to outer margin; M_3 fused with Cu_1, and **1st A** completedly free, **2d A** long, with the lower leg of its basal fork strong. Hind wing nearly as wide; costa not sinuate; **Sc** long; **R** and M_1 nearly parallel; anal region small but fully veined, as usual; M_2 and M_3 connate or stalked in the typical group, but separate in our species.

Larva with tufted hair from small warts; with from four to eight setæ on the ventral leg plates; prolegs not especially long, with a complete circle of bi- or tri-ordinal hooks. Pupa with parts practically completely soldered; wings extending to the seventh segment of the abdomen; antennæ meeting in the middle line, not reaching the end of the wings, which also meet; epicranial and frontoclypeal sutures complete. Prothorax Gelechiid, rather wide; maxillary palpi minute; labials exposed; fore femora concealed. Abdominal spiracles tubular; setæ mostly hooked, including the cremastral ones.

This genus represents a small group with a curious mixture of Gelechiid and Yponomeutid characters in pupa and adult, which is sometimes placed in the Gelechiidæ, or made a separate family. There are but few genera, though Scythris has a large number of species in Europe. Most of our species will probably be removed on venational characters, but for the present the series had better be treated as a single genus. Colinita is very close, but has R_1 in its normal position and M_3 preserved.

Key to the species

1. With erect postmedial and oblique antemedial pale bars.....1. *impositella.*
1. With a spot in fold and a bar at two-thirds.....2. *graminivorella.*
1. No pale bars.
2. Apex with golden scales; typically, with a golden streak in base of fold also. 5. *basilaris.*
2. Dorsal third dusted with yellow.....6. *pilosella.*
2. Solid blackish.....3. *fuscicomella*, 4. *eboracensis.*

1. **S. impositella** Zeller. Head, thorax, and forewings blackish, with some purple iridescence; tegulæ pale; two greenish white, somewhat diffuse fasciæ, the more basal one oblique and curved, with the lower part longitudinal, the outer erect and oval. A pale dot at base of wing. 12 mm. (*matutella* Clemens).

General. New York: Rock City, West Farms.

S. trivinctella Zeller, a related species with more white at the base and with a zigzag postmedial fascia, is to be expected in the west of our territory.

2. **S. graminivorella** Braun. Dark brown, faintly brassy; palpi slightly paler inwardly and at bases of segments. Fore wing streaked with paler scales that gather to form distinct dots, the first in the fold at one-third, the second an oblique bar at two-thirds, and a third at the apex. Antemedial spot defined with a vague darker area, lacking the pale scaling, and a similar area between the outer bar and the apex. Hind wings darker, purplish. Abdomen pale below. 11 mm.

Larva a leaf-miner in grasses (Hystrix, and more rarely, Poa), making several

mines, whose entrance is guarded with a broad tube of silk. Larva in May; moth in early June.

Cincinnati, Ohio.

3. **S. fuscicomella** Clemens. Black-brown, slightly iridescent, with a slight yellowish iridescence except on fringe.

This is probably the same species as the next. It was taken in June. Larvæ with *S. eboracensis*.

Pennsylvania.

4. **S. eboracensis** Zeller. Wholly blackish. Base of palpi whitish on outer side. 9–12 mm.

June and July; end of August and September. Larvæ in webs in tops of thistle.

Maine to Texas. New York: Rock City (Cattaraugus County), Portage, Crugers, Sea Cliff, Long Island.

5. **S. basilaris** Zeller. R_4 and R_5 wholly united, running to apex. Purplish fuscous. Face ochreous at the sides in variety **flavifrontella** Clemens. Fore wing with a few golden bronze scales, forming a spot at the apex of the membrane, and often a streak in the base of the fold. 12 mm.

In variety *flavifrontella* the apical spot is also enlarged.

Distribution general in June and July. New York: Keene Valley; Cold Spring Harbor, Long Island.

6. **A. pilosella** Zeller. Brown. Palpi yellow-brown; inner third of fore wing with scattered, slender, yellow hairs. No iridescence. 10 mm.

This species is unknown to me.

Massachusetts.

7. **S. aterrimella** Walker, a plain blackish species from west of Hudson Bay, is unknown to me; it is possibly the same as *S. eboracensis*, but the male genitalia would have to be studied to make sure.

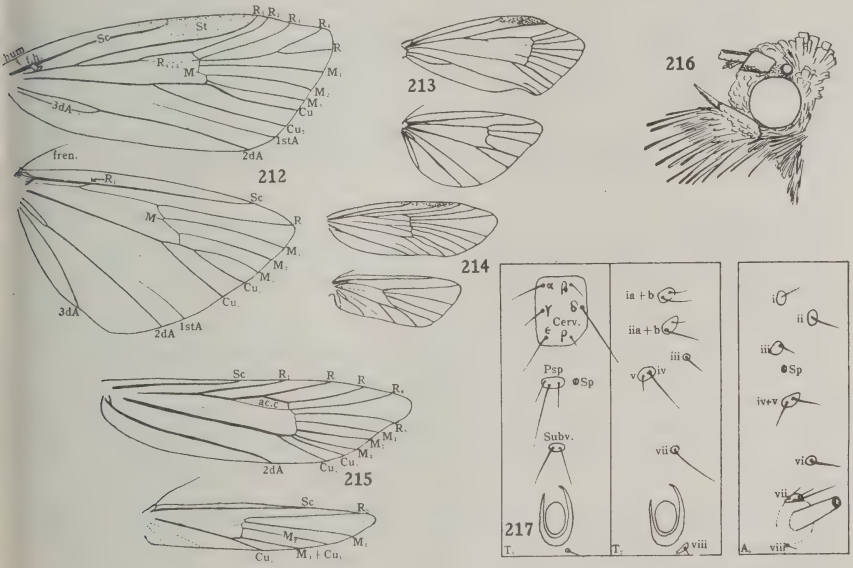
S. charon Meyrick, described from North Carolina, has a pale streak in the fold.

Family 25. GLYPHIPTERYGIDÆ

(*Choreutidæ; Hemerophilidæ; Yponomeutidæ,* in part)

Head smoothly scaled; ocelli in our species large and conspicuous; tongue scaled at base; maxillary palpi minute; labial palpi upturned to middle of front or beyond, sometimes beyond vertex; normally smooth scaled, but often with long loose hair on second joint or rough hair on second and third joints. Antennæ without pecten; with the outer row of scales of each segment usually complete, but narrow, and the inner row broadly interrupted below and replaced by conspicuous sense-hairs (minute in the Florida genus Tortyra). Middle and hind tibiæ with more or less hair above, which tends to be stiff and to gather opposite the spurs; or else smooth scaled. Wings exceptionally broad; macro-like in shape; sometimes with the fringes not wider than in some macros, and but little lengthened at the anal angle; only in Glyphipteryx, lanceolate with broad fringes, and even in this genus with rounded apex. Fore wing with a large accessory cell, and often with base of **M** more or less preserved; cell normally almost squarely cut off at end; R_4 and R_5 stalked only in Allonoyma, R_5 running to apex, or, usually, to outer margin; Cu_2 arising close to angle of cell; **1st A** rather weak, free; **2d A** with a large basal fork. Hind wing usually somewhat

smaller, ample except in the more reduced Glyphipteryxes; **Sc** connected to **R** by a more or less distinct crossvein; **R** and $\mathbf{M}_1$ separate, parallel or divergent; $\mathbf{M}_3$ and $\mathbf{Cu}_1$ approximate, stalked, or united. $\mathbf{Cu}_2$ farther from angle of cell than in fore wing, and without a fringe of



FIGS. 212–217. GLYPHIPTERYGIDÆ

212, *Simaëthis diana*, venation; **213**, *Choreutis pretiosana* (Europe), venation; **214**, *Glyphipteryx loricatella* (Europe), venation; **215**, *Glyphipteryx impigritella*, venation; **216**, *Choreutis* species, side view of head; **217**, *Simaëthis fabriciana* (Europe), seta map of larva

hair on base of **Cu**; **1st A** and **3d A** sometimes weak; **2d A** strongly forked at base, more so than in any other frenate known to me.

Egg of upright type. Larva (fig. 217) with front acute, extending well toward, but not reaching, vertex; ocelli normal; upper anterior seta of cervical shield farther from middle line than upper posterior seta; abdomen with seta **i** nearer middle line than **ii**, even on the eighth segment; **iv** and **v** close together; prolegs slender, with a complete, but often weak, circle of uniordinal hooks. Pupa (described by Miss Mosher as Heliodinidæ) incomplete, with some motion even between the second and third abdominal segments; with some cremastral setæ, but no true cremaster. Abdominal segments with anterior rows of fine spines only; wings reaching the fourth segment of abdomen; spiracles not distinctly tubular; maxillary palpi, labial palpi, and front

femora all exposed; antennæ not meeting in the middle line and not reaching the end of the wings; tongue moderate or reaching end of wings; prothorax and dorsal head piece both rather narrow, distinct, and sub-equal; mesothorax extending back as a long lobe in mid-dorsal line, nearly cutting the metathorax in two.

The Glyphipterygidæ are a small and homogeneous family, with a distinct relationship to the Tortricidæ with which they have sometimes been united. They are very close to the Yponomeutidæ in adult characters, but well separated from them in the early stages, especially by the normal incomplete pupa. There are about 550 species, largely Oriental. Setiostoma, formerly placed here, belongs near Stenoma.

Key to the genera

1. Third joint of palpus twice as long as second, smooth.....1. **Abrenthia.**
1. Third joint of palpus but little if at all longer than second.
2. Second segment of palpus with long hair below, about as long as the segment .....3. **Choreutis.**
2. Palpus not reaching vertex; with rough-scaled second joint..2. **Simaëthis.**
2. Palpus smooth, upturned beyond vertex.....4. **Glyphipteryx.**

1. *ABRENTHIA* Busck

Wings ample; venation as in Glyphipteryx; fore wing with cell two-thirds as long as wing; hind wing widening outward, as in Glyphipteryx, with cell half as long as wing. Palpus with third segment longer than first and second together; smooth.

1. **A. cuprea** Busck. Deep purple; head and tegulæ golden bronze, thorax darker. 11 mm.

Late June and July.

Quebec; Pennsylvania; Virginia.

2. *SIMAETHIS* Leach

(With *Brenthia* Clemens, *Orchemia* Guenée, *Hemerophila* Hübner (Tentamen), *Allononyma* Busck)

Fore wing (fig. 212) triangular with moderately short outer margin and marked anal angle; hind wing rounded-triangular, with anal region broad, and all veins developed; 3d A long. Cells of moderate length. Wings marked with metallic scales. Palpi with second and third joints slightly thickened with rough scales.

Our four species represent three different groups. The first three occur also in Europe, most of the relatives of the fourth are tropical.

I. *Fore wing more perfectly triangular, with marked apex; outer margin concave above and below middle, the fringe marked there with white. Palpus with third joint cylindrical; thick in side view. Fore wing with* R_4 *and* R_5 *normally separate* (Simaëthis).

1. **S. fabriciana** Linnæus. Mottled dull brown, with obscure markings suggesting a small noctuid; the two white streaks in fringe covering two-thirds of the width of the fringe, contrasting. 12 mm.

June. Larva on nettle, etc. Dull yellowish; head black; clypeus and a couple of spots on cheeks pale; cervical shield, anal plate, and true legs black; the shield

livided. In a web at tip of leaf in April, July, and August. Cocoon dense, white. Ottawa, Ontario; Montreal, Quebec; Europe. A paler form occurs in Colorado.

2. **S. pariana** Clerck. Similar to *S. fabriciana*, but with the markings even more obscure, and the white in the fringe confined to the tips of the outermost scales. 10 mm.

August. Larva on apple: a leaf-roller.

Tarrytown, New York, introduced from Europe.

I. *Fore wing triangular with marked apex, but even and slightly convex outer margin; the fringe wholly and evenly fuscous. Palpi as before.* R_4 *and* R_5 *stalked halfway to apex* (Allononyma).

3. **S. diana** Hübner. Gray, powdery, and mottled with fuscous; with three obscure, broken, and irregular transverse bands, partly defined with white. Sometimes distinctly greenish. 15 mm. (*Hemerophila vicarialis* Zeller; *betuliperda* Dyar.)

Larva translucent greenish yellow. Head pale reddish with a black line on sides behind; tubercles black; body with a clear white dorsal, and blurred lateral lines; under a web on upper side of leaf of birch; eating upper parenchyma only. Cocoon fusiform, with truncate ends, under a carpet, denser than the larval web

Nova Scotia to White Mountains, New Hampshire; west to British Columbia and Utah.

The status of this species is uncertain. The green (*diana*) and gray (**betuliperda**) forms are rarely found together, but each covers the range of the species. *Vicarilis* was described as largely light brown. I have seen no such specimens and it may be stained *betuliperda*. Variants of both green and gray forms occur in Europe. If these European types prove to be a distinct species, *diana* will have to be used for them and *vicarilis* is available as the name for our species.

II. *Fore wing with costa more arched, apex rounded, outer margin evenly convex, more upright than before, with metallic scaling. Palpi with third joint chisel-shaped, appearing pointed in side view, but as broad as second, to its apex, in front view* (Brenthia *Clemens*).

4. **S. pavonacella** Clemens. Fuscous. Lower part of face pale; palpi white with three fuscous rings; antennæ barred above; fore wing mottled with whitish, especially about the middle; a broad black terminal band, containing a streak of bright iridescent scales, often broken into spots, and with a few such scales at middle of costa. Hind wing fuscous, not powdery; shaded with whitish, with a short metallic band near apex. 8 mm.

May; July and August. Larva on Desmodium and Amphicarpa. The moth flutters about on alighting, with hind wings displayed like Glyphipteryx, the smaller Anacampses, etc.

New York and Pennsylvania to Brazil, west to Kansas. New York: Ramapo.

3. *CHOREUTIS* Hübner

(*Porpe* Hübner)

Costa strongly arched (fig. 213), apex more or less marked; anal angle marked only in *C. inflatella*. Hind wing rounded, the first two anal veins not closely parallel. Palpi with long acute third joint; and long stiff hair-scales on the under side of the second joint (fig. 216), sometimes in two slightly divergent sets. Antennæ sometimes with a triangular mass of projecting scales on lower side of base.

Key to the species

1. Fore wing with two silvery streaks from costa; hind wing with a silver bar ..... 1. *inflatella*
1. Fore wing with silver broken into spots; hind wing with white only.
2. Fore wing white at base ..... 6. *leucobasis*
2. Fore wing ochreous and brown at base.
3. With silver markings in specular region only ..... 5. *extrincicella*
3. With silver markings on costal half of wing outwardly.
4. Fore wing with little or no yellow at base, but with two prominent transverse white fasciæ ..... 2. *onustana*
4. Fore wing with more yellow at base, and without white fasciæ.
5. 9 mm. Medial area powdery like ground ..... 3. *gnaphaliella*
5. 13 mm. Median area even chocolate brown ..... 4. *carduiella*

I. *Fore wing triangular, with marked anal angle; hind wing with all veins preserved;* **R** *running to apex* (Choreutis).

1. **C. inflatella** Clemens. Dark brown, with some ochre toward apex; disc dusted with white; some silvery marks near base; a curved postmedial band and a straight subterminal one converging toward anal angle; a couple of white spots on costa. Fringe pale, with fuscous center-line. Hind wing fuscous, with a silver subterminal bar, and dot at anal angle. All the silver typically greenish but violet in the commoner variety **virginiella** Clemens. 9 mm.

June and July; September. Larva skeletonizing *Scutellaria lateriflora*, in a slight web bending the leaf up and the edges together; in early September. Cocoon usually in an uneaten leaf.

Toronto, Canada, to North Carolina and Washington. New York: Wilmington, Batavia, Ithaca, West Farms.

II. *Fore wing blunter, with more arched margins, and anal angle not marked;* M_3 *of hind wing normally lost;* **R** *running to costa* (Porpe).

2. **C. onustana** Walker. Brown; yellowish at base of cell, with two lead-gray streaks at base of wing and several spots outwardly in black patches; terminal line double, fuscous. 9 mm. (*ohioensis* Zeller).

June and July.

Canada to Pennsylvania, British Columbia, and California. New York: Mt. Whiteface, Uphill Brook (Mt. Marcy), East Aurora, Ithaca.

3. **C. gnaphaliella** Kearfott. Light brown or fuscous, with bright ochre yellow patches at base, defined by the lead-colored streaks on costa, **Cu,** and inner margin. Outwardly, with lead-colored and black patches as in *C. onustana*. With white dusted areas, tending to form a band across apex from middle of costa to middle of outer margin, and a broader and less regular one from before middle of costa to anal angle, the two often connected along lower edge of cell. Hind wing fuscous with a short white line. 9 mm.

Generally distributed. May to July; September and October. Larva on Antennaria and *Gnaphalium polycephalum;* a leaf miner when young later in a stick web mixed with frass; gregarious in spinning its cocoon.

4. **C. carduiella** Kearfott. Closely similar to *C. gnaphaliella;* the white dash on the hind wing, on the average, weaker, sometimes wanting; the two powdery areas almost always entirely separate; the median area, and the subterminal region before the black mark, even bright chocolate brown. 13 mm.

Larva pale yellow. Head, cervical shield, and true legs light brown; a black spot low down on side of head; tubercles black, stronger on thorax. Social, in pith of stems of *Carduus spinosissimus*, in June. Two broods. Moth in July and in November. Very close to *C. pretiosana* of Europe.

5. **C. extrincicella** Dyar. Light brown. Head paler, fore wing with a broad whitish antemedial band, edged outwardly toward costa with silver, and filled with silver below. Outer half, except extreme margin, cream, shaded with chreous and light brown; above, with black streaks; below, with a large black atch containing two silvery spots; a yellow-brown terminal band. Hind wing whitish. 12 mm. (*Millieria*).

June.

Western Pennsylvania; Wisconsin; Regina, Canada; California.

6. **C. leucobasis** Fernald. Head, thorax, and base of fore wing white; or pale ray with a white antemedial band. Outer two-thirds of wing dark fuscous, usted with white, and shading into a white central patch; three oblique white treaks near apex of costa, the largest at apex. With scattered metallic spots, specially below the white patch. Hind wing fuscous. 12 mm. (*Millieria*).

June to September.

Vermont, Massachusetts, and Ontario to British Columbia.

4. *GLYPHIPTERYX* Hübner

Palpi upturned about to vertex, smooth; ocelli present. Fore wing long and arrow, with strongly oblique outer margin and sometimes with marked anal ngle (figs. 214 and 215); the apex tending to be subfalcate, but rounded off. find wing narrower, and much shorter; typically oblong; sometimes lanceolate, ut with rounded apex; **R** sometimes running to apex. Cell very small in ample- inged forms. M_3 connate, stalked, or united with Cu_1. Hind tibiæ smooth- caled. *Quinqueferella* of California is not a Glyphipteryx but a Hilarographa.

1. **G. saurodonta** Meyrick. Dark bronzy gray. Head with a white line above yes; palpus with three whorls of white-tipped black scales; apex of third segment lack with white lateral lines. (Wing form and venation not stated.) Fore wing ith a semioval white dorsal spot before the middle; six white, dark-defined costal triæ, the first two oblique, extending half way across the wing, the first at a hird way out, and the second at the middle; the others shorter and erect, the ast two being approximated. A wedge-shaped dorsal streak beyond the middle, early meeting the second costal, and a shorter erect subterminal streak with a whitish area before it. Two lead-colored metallic spots on disc and three on orsal half of outer margin. Apex blackish with a silvery dot. Fringe gray, dark t the base; apical hook black, with a white streak below it. 10 mm.

September.

Toronto, Ontario. This species is unknown to me.

2. **G. circumscriptella** Chambers. Hind wing narrow and short, but trapezoidal; he fringe wider than the wing; venation normal; M_3 and Cu_1 connate.

Dull gray-brown with slight iridescence; a large white dorsal triangular streak ith straight outer, and slightly bent inner, edge; hardly dark-edged, and running wo-thirds way across the wing; beyond, with two erect silvery costal streaks, xtending half way across wing, and one dorsal one. Speculum black, extending o a rudimentary second outer dorsal streak, interrupted by two silver spots. ontaining also a couple of silvery and several yellow spots, and with a black- usted, straw-yellow patch above it. A curved blue streak from middle of outer argin to three-fourths way out on costa and a white subterminal bar beyond it. 2 mm.

Fabiola shalleriella has been mistaken for this species, but can be easily dis- nguished by its much longer palpi and hairy hind tibia.

July.

Mt. Wachusett and Amherst, Massachusetts; Essex County, New Jersey. The pecies is in the Robinson collection, presumably from New York.

3. **G. quadragintapunctata** Dyar. Palpus apparently like that of Abrenthia, but ing with markings of Glyphipteryx. Fore wing dark brown; the median area

darker, sprinkled with golden dots on the dorsal three-fifths; apex ochreous, a series of yellowish white, more or less opalescent dots on costa, the second and fifth continued into complete transverse lines, the fifth extending to the anal angle, the fourth oblique to the middle of the wing, the seventh a short line, and the eighth to the middle of the outer margin; no spot at middle of inner margin. Hind wing brown. 14 mm.

This species may fit better in the South American genus Machlotica Meyrick.

Onaga, Kansas.

4. **G. impigritella** Clemens. Fore wing (fig. 215) with sublanceolate subfalcate membrane; cell nearly two-thirds of the length of wing; **1st A** wholly lost; basal fork of **2d A** obscure; hind wing half as wide as fore wing, lanceolate, with fringe wider than membrane and reduced anal region; with base of **R** wholly lost; **R** and M_1 connate; M_3 lost. Olive brown; fringe paler, grayer, and glistening; apex of membrane with a black spot. Markings silvery white, edged more or less with black, especially on their inner sides; basal half of costa immaculate; outer half with five transverse bars, the first two converging at the middle of the wing and nearly meeting a very large crescentic one from before the middle of the inner margin and another running directly across from the inner margin; third costal bar smaller, solitary, opposite a small one at anal angle; fourth and fifth bars close together, near the apical spot, with a single corresponding one in the dorsal fringe. Fringe white with a heavy black line in the base. 7 mm. (*exoptatella* Chambers).

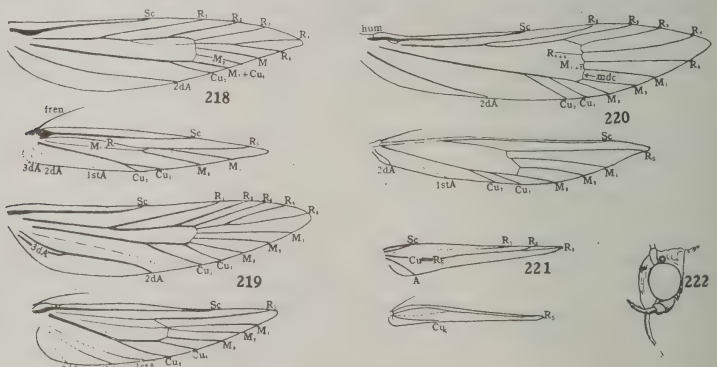
The moth flies in June in North Carolina.

New Hampshire to Texas and California.

Family 26. **HELIODINIDÆ**

(*Lavernidæ, Elachistidæ,* in part; *Tinægeriidæ,* in part, etc.)

Head smooth-scaled, with rather small eyes; antennæ normally about as long as fore wing, (short in Cycloplasis), with small first joint and



FIGS. 218–222. HELIODINIDÆ

218, *Heliodines rœsella* (Europe), venation; **219**, *Euclemensia bassettella,* venation; **220**, *Schreckensteinia* species, venation; **221**, *Cycloplasis panicifoliella,* venation; **222**, *Heliodines* species, side view of head

annulate shaft; palpi varying from very short to moderate, sometimes drooping, apparently socketed in face; maxillary palpi obsolete; tongue

normally strong and naked; ocelli variable; hind tibiæ smooth-scaled or with stiff bristles; hind tarsi with more or less distinct groups of bristles at ends of segments. Fore wing lanceolate or linear; hind wing narrower; cell usually open below **M**; and usually reduced in venation.

In delimiting this family, I have blindly followed Meyrick's revision. It appears homogeneous except for Euclemensia, which lacks the enlarged tarsal spinules and may prove to be a new family type. The most characteristic feature of this family is the resting position, the middle or hind legs being always, so far as known, conspicuously displayed, either raised, or held out laterally. Heliodines, Stathmopoda (Erineda), Schreckensteinia, and Cycloplasis are known to do this, as well as various exotic forms. Meyrick admits about 225 species. Stathmopoda is the only considerable genus.

The early stages are various. The egg of Schreckensteinia is upright; those of the rest I think are unknown. The larvæ are various (see Euclemensia, Schreckensteinia, Heliodines, Cycloplasis). The pupa of Schreckensteinia (q. v.) is known. It is formed in a lace cocoon. The parasitic Euclemensia pupates in the host.

Key to the genera

1. Hind wing banded with silver.....4. **Idioglossa.**
1. Hind wing immaculate.
2. Fore wing with R_5 preserved, running to costa (fig. 219).
3. Hind wing nearly as wide as fore wing; hind legs unarmed. 1. **Euclemensia.**
3. Hind wing linear; hind tarsi heavily spined.....3. **Erineda.**
2. Fore wing with four veins or less running from cell to costa.
3. Venation reduced to three or four veins.....5. **Cycloplasis.**
3. Venation fairly complete.
4. Hind wing lanceolate; M_3 lost.....2. **Heliodines.**
4. Hind wing with all veins preserved, or linear and very narrow with all veins obsolescent .....6. **Schreckensteinia.**

1. *EUCLEMENSIA* Grote

(*Hamadryas* Clemens, not Hübner, etc.)

Head smooth; palpi upturned to vertex, smooth; maxillary palpi very minute, porrect. Tongue small, scaled; antennæ slightly rough-scaled. Tarsi with spinules very weak, tending to gather at tips of segments. Fore wing (fig. 219) with costa concave at middle, dorsal margin arched; hind wing nearly as broad, bluntly lanceolate, without emargination on costa; all veins widely separate. R_1 obsolete.

Caterpillar an internal parasite on the oak soft scale, Kermes; forming a crescentic chamber in the body of the host, which finally becomes very hard and gall-like. Caterpillar white, with brown head, very plump, and strongly concave *dorsally*. Setæ minute, not yet worked out. Prolegs rudimentary, with a circle of uniordinal books. Pupa in the infested gall; not studied.

The caterpillar cuts a sort of lid in the Kermes for the moth to emerge.

This is a curious and entirely isolated genus, being the only known internal parasite in the order. It is usually placed in the family Œcophoridæ, as its

venation would indicate, but the wing form and maxillary palpi are not Œcophorid.

1. **E. bassettella** Clemens. Bronze-black; palpi yellow. Base of fore wing orange-red, bounded by a raised bar on inner half and a dot on costa, and marked with a black bar from base of costa, and streak on inner margin. Outer two-thirds nearly black with an orange-red band running through the middle of the wing to the costa before the apex, leaving only a slender black streak. 15 mm.

July and August.

New Hampshire, and Ontario to Texas. New York: Ithaca (Howard, W. T. M. F.), Nyack (Zabriskie); Flatbush, Long Island.

2. *HELIODINES* Stainton

(*Ætole* Chambers)

Palpi smooth, third joint pointed (fig. 222), antennæ about as long as body; hind tibiæ smooth-scaled; fore wing lanceolate (fig. 218); our species with 10 veins, the two apical forking over the apex, Cu_2 apparently lost. Hind wing narrower, lanceolate, with **R** and M_1 long-stalked, forking over apex; M_2 free, connected by a short cross vein to **R**-stem; cell open below it; our species with **Cu**-stem simple. Ocelli present. Larva of European species in a slight web, on Chenopodiaceæ.

1. **H. bella** Chambers. Fore wing deep orange; base marked with mouse-gray; also, with two gray spots on costa and two on dorsal margin; costa, outwardly, and inner margin, from beyond middle, edged with mouse-gray; fringes, body, and hind wings mouse-gray. The fore wing with the small gray spots raised, and with similar raised tufts in the gray border. 7 mm.

The moth has been taken on Chinquapin bloom.

Kansas and Kentucky to California and Texas.

2. **H. nyctaginella** Gibson. Similar, larger; costa with gray edge at base only, followed by four raised spots; inner margin with no separate spots; the antemedial tuft connected to the base, and the postmedial tuft to the apex by gray stripes. 10 mm.

August. Larva on *Oxybaphus nyctagineus.*

Madison, Wisconsin; Manitoba; Ames, Iowa.

3. *ERINEDA* Busck

(*Stathmopoda,* in part)

Antennæ two-thirds as long as fore wing, without pecten, but with whorls of long hair in male. Palpi upturned, slightly thickened, third segment rather shorter than second. Scales small, slender, and smooth. Tongue small; maxillary palpi apparently absent; hind tibiæ with tufts of spines above the spurs, the outer end-spur as long as the inner, and both long. Tarsi also with whorls of spinules. Fore wing slender, but wider than in the European genus Stathmopoda; lanceolate; with 11 veins; R_1 and R_2 approximate; R_3 short-stalked with R_{4+5} all running to costa; M_1 absent, Cu_2 arising well back on the cell; M_2, M_3, and Cu_1 equidistant. Hind wing half as wide, lanceolate; veins all free but crowded; cell open above M_2. R_1 apparently free from the short **Sc** in the hind wing, as in Stathmopoda.

This genus is most probably Heliodinid, but will ordinarily be sought in the Lavernidæ. The moth of Stathmopoda rests with the middle legs extended laterally and the tufted hind legs raised.

1. **E. elyella** Busck. Brilliant golden bronze; the costa and inner margin contrastingly pale golden in most lights. 9 mm.

East River, Connecticut.

4. *IDIOGLOSSA* Walsingham

(*Metamorpha* Frey and Boll, not Hübner, Walker, or Stainton; *Idiostoma* Walsingham)

Vertex and front smooth scaled; the front strongly narrowed below, as in Coleophora. No ocelli; scape of antennæ very long; pecten apparently absent; a notch in base of shaft. Palpi widely divergent, second segment slightly thickened, third as long as second. Maxillary palpi drooping, clothed with a conspicuous tuft of hair-scales; tongue scaled; hind tibiæ with two or three regular series of bristles. Mid-tibiæ smooth. Wings linear; R_5 running to costa; cell low in wing, oblique, like Coleophora; one dorsal vein lost. Hind wing linear.

This is a very striking genus, distinguishable from all our other narrow-winged Tineina by the metallic bands on the linear hind wings. The relationship is entirely uncertain. The genus shows resemblances to Coleophora, Cosmopteryx, Batrachedra, and the Gracilariidæ. There is another species in South Africa, and two more in India.

1. **I. miraculosa** Frey and Boll. Straw yellow. Palpi and maxillary tuft nearly white. Fore wing with an oblique brownish fascia a third way out, nearer the base on dorsal margin, sending a point outward along the middle of the cell, and edged with violet-silver. Another fascia running obliquely outward from the beginning of the costal fringe, edged within with silver; and brownish fuscous streaks in the fringe below. Extreme apex silvery. Hind wings nearly concolorous, with three silvery fasciæ somewhat edged with brownish, the outer one followed by a stronger brown shade which extends into the fringe. Two brown scale-tufts in dorsal fringe of fore wing and one on hind wing. 10 mm.

Caterpillar on *Panicum clandestinum*, in a translucent white silken tube on the under side of the blade, attached through a hole to the upper side of the leaf, which the larva skeletonizes. Pupation in the tube, which is trussed up and enclosed in loose silk.

Southern States, north to southern Ohio.

5. *CYCLOPLASIS* Clemens

Antennæ very short, hardly more than half as long as body; palpi short, divergent, oblique in life, slightly curved, with terminal bristles; with flat scale-masses beside the tongue, possibly representing the maxillary palpi; Tongue somewhat longer than face. Fore wing linear-lanceolate (fig. 221); **R** near costa, simple, fading out at base; a vein through middle of wing, furcate over apex (representing R_5 and **M**); **Cu** very short and simple. Hind wing linear, abruptly broadened at base, with a simple vein running to apex, and a fragment of **Cu** in the basal lobe. Middle and hind tibiæ and tarsi heavily spined; hind legs elevated in the resting position.

The larva lives in a long linear mine, which is later enlarged into a blotch. When mature, it cuts out an oval piece of the mine, and folds it lengthwise to form a cocoon, in which it drops to the ground and anchors itself. A mass of white froth is ejected from the end of the cocoon. I suspect the pupa is obtect.

This isolated genus is placed here by Meyrick; the peculiar cocoon would suggest rather the Heliozelidæ, but the food and maxillary palpi may indicate more direct kinship with Idioglossa.

1. **C. panicifoliella** Clemens. Head and thorax lead-color; antennæ brown, with silver toward base; fore wing umber brown, more or less violet, with a broad straight bright silvery fascia a third way out, and suffused with silver in apical half, especially toward costa; fringe and hind wing violet brown; fringe of hind wing fuscous.

The larva works in *Panicum clandestinum* early in July; the mine begins at the base of the leaf and runs to the tip and part way back before the enlargement begins to be formed.

Distribution probably general; moth in late July and August.

New York(?); Pennsylvania; Ohio.

6. *SCHRECKENSTEINIA* Hübner

(*Chrysocoris* Curtis)

Rather similar to Epermenia and possibly related to it. Head similar; no pecten; fore wing similar (fig. 220), with **Sc** much longer than **2d A**, not distinctly falcate, but lanceolate; without dorsal tufts; all veins present; R_5 ending just below apex. Hind wing with **R** running to just below apex and never stalked with M_1. Hind tibiæ with a single series of bristles above; palpi short, divergent.

Egg of upright type. Larva with setæ iv and v separated only in first stage, then on one tubercle; setæ i and ii glandular, as in some Pterophorids, adjacent at base. Prolegs long and slender, with only 4 to 6 hooks in a circle at the tip. Cocoon of regular meshes; the larval skin thrown out through a hole. Pupa incomplete; emerging from the cocoon; with segments 3 and 6 free, and 7 in male; with heavy dorsal spines and recurved hairs on fifth to ninth segments of abdomen, and small ones on the third segment also; spiracles on high cones; maxillary palpi very small, dehiscing with legs; palpi and femur exposed; first legs touching antennæ at base; the others reaching tip of wings; prothorax minute; headpiece larger.

The genus curiously combines Yponomeutoid and Pterophorid characters, and was for a time placed in the Pterophoridæ. Meyrick puts it here, however, but Spuler, in the Scythrididæ, with Epermenia.

1. **S. erythriella** Clemens. Reddish fuscous, with a more or less distinct greenish brassy hue; palpi ochreous with a fuscous tip; fringes fuscous. Hind wings reddish fuscous with concolorous fringes. 9 mm.

August. Larva in July in fruit racemes of sumac. Strongly moniliform, with raised tubercles; dark green, with rather small, pale brown head. Cocoon of large meshes; pupa green; on outside of raceme.

Distribution probably general. New York: Ithaca, Albany.

2. **S. feliciella** Walsingham. Deep bronze brown; browner and darker than *S. erythiella;* palpi with dark third joint. 9 mm.

This species was bred from Orthocarpus. The eastern record is very likely in error for an aberration of *S. erythriella.*

Pacific Coast; Hazelton, Pennsylvania.

3. **S. festaliella** Hübner. Fore wing light olivaceous and brown, with a slight golden iridescence; contrastingly veined with dark brown. 12 mm.

April and May; July and August. Caterpillar green with brown head, on Rubus leaves, in a slight web; the cocoon as in *S. erythriella.*

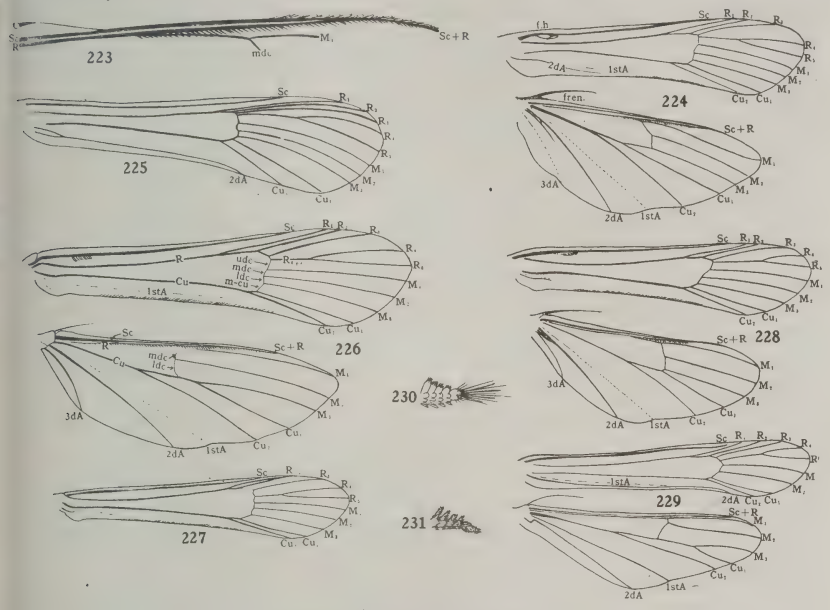
Known from Massachusetts to western Pennsylvania and Michigan; Europe. New York: Ithaca, Rock City.

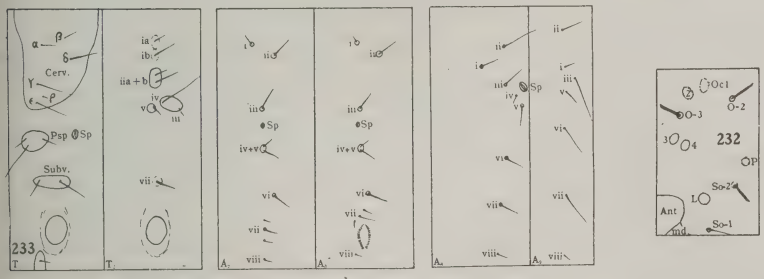
Family 27. ÆGERIIDÆ

(*Sesiidæ; Sphingidæ,* in part)

Head rather small; body often stout; mostly smooth-scaled; sometimes with rather finer hair-scales; ocelli present; palpi moderate, upturned often to vertex, normally smooth-scaled, without bristles. Antennæ usually fusiform, tapering to both base and apex, the terminal

gment (fig. 230) ending in a minute tuft of bristles (terminal joint Bembecia enlarged and pubescent only, fig. 231); sometimes pectinate,





FIGS. 223–233. ÆGERIIDÆ

223, *Ægeria apiformis:* costa of hind wing, showing recurved spines on vein R; **224**, *Melittia cucurbitæ*, venation. (In this and the following figures the costal region of the hind wing is shown a little more spread out than it is actually on the wings.); **225**, *Ægeria apiformis* (Europe), venation of fore wing; **226**, *Conopia (Sanninoidea) exitiosa* ♀, venation; **227**, *Conopia (Chamæsphecia) tipuliformis*, venation of fore wing; **228**, *Albuna pyramidalis*, venation; **229**, *Bembecia marginata*, venation; **230**, tip of right antenna of *Ægeria apiformis;* **231**, tip of right antenna of *Bembecia marginata;* **232**, arrangement of ocelli of larva of *Ægeria apiformis*, penultimate stage, typical of the family; **233**, *Memythrus tabaniforme* (Europe), beta map

and when pectinate, with dorsum evenly scaled, with two widely over lapping rows of scales to a segment, often with only the tips of on row exposed; when not pectinate, with base usually fully scaled, middl of shaft with the outer whorl of each segment continuous, and the inne interrupted by a broad sensory area below; in both forms with mos of the swollen tip covered by a sensory area, which bears only scat tered scales. Maxillary palpi minute, of porrect type; tongue strong naked; legs often with stiff bristly hair gathering in tufts at the spurs sometimes with fine hair also. Fore wings (figs. 224–229) very nar row, with short outer margin, and well-marked anal angle; often trans parent; $\mathbf{R}_5$ stalked or united with $\mathbf{R}_4$; accessory cell and base of media lost; $\mathbf{Cu}_2$ arising well out toward apex of cell; anal region extremel reduced, the anal veins weak or rudimentary. Hind wing usuall broader, but narrow; more or less extensively transparent in our species often with only the margins and veins scaled; costal edge (fig. 223 with **Sc** and **R** closely parallel, becoming coincident outwardly, an bearing a series of recurved spines, which interlock with a simila series on the inner margin of the fore wing. Cell usually squarel closed; anal region fully veined. Frenulum simple in both sexes. Th sex is most easily determined by counting the number of visible abdom inal segments, there being six in the female and seven in the male or by the larger male antennæ. The body markings on the basal par of the abdomen are usually alike in both sexes, but the last ban is very generally a segment farther toward the apex in the male tha in the female. Anal tuft always conspicuous in male, simple or rudi mentary in female.

Egg of the flat type, oval. Larva (figs. 232, 233) white; withou markings; boring. Front nearly or quite reaching vertex; tubercle usually moderate (obsolete in Melittia). Posterior addorsal setæ on cer vical shield nearer middle line than anterior; abdomen with tubercle **i** and **ii** separate, **iv** and **v** adjacent; spiracle of eighth segment abov the level of the others; spiracles elliptical. Ventral prolegs with tw transverse rows of uniordinal hooks; anals with a single row. Pup incomplete, usually formed in the tunnel; with only a couple of basa segments immovable, and even these loosening on dehiscence. Labia and maxillary palpi exposed; tongue and antennæ not reaching th tips of the wings; the antennæ normally swollen toward tip; prothora wider than dorsal head-piece. Last segment with ventral spines, bu cremaster not even represented by specialized setæ. Two rows o spines to each segment dorsally.

The connection of this family with the Yponomeutoidea is unmistak able but, at least as represented in the United States, it is clearly define both in adult and pupa.

Key to the genera

1. Antennæ with last segment minute, bearing a tuft of bristles (fig. 230).
2. Cu_1 in hind wing much nearer Cu_2 than M_3 at origin (fig. 224)..2. **Melittia.**
2. Cu_1 approximate, connate, or stalked with M_3.
3. M_2 and M_3 of fore wing strongly downcurved; Cu_1 and Cu_2 straight (fig. 225) .....7. **Ægeria.**
3. M_2 and M_3 practically straight (fig. 226).
4. M_3 and Cu_1 approximate at origin in hind wing.....1. **Memythrus.**
4. M_3 and Cu_1 stalked.
5. Fore wing with R_1 absent, indicated only by a slight fold and thickening .....8. **Alcathoe.**
5. Fore wing with all veins preserved.
6. Palpi with loose bristling hair below.....3. **Podosesia.**
6. Palpi smooth, or somewhat rough-scaled below.
7. Hind tibiæ nearly smooth throughout.....5. **Parharmonia.**
7. Hind tibiæ tufted at the spurs, smooth between.....6. **Conopia.**
7. Hind tibiæ wholly rough-haired.....4. **Sannina.**

1. Antennæ not ending in a tuft of bristles; last segment large and pubescent (fig. 231) .....9. **Bembecia.**

Key to the known larvæ

(After Dyar)

Segments 3-annulate; tubercles distinct.
1. First annulet the highest.
2. A black band across bottom of clypeus.....*Memythrus dollii.*
2. A brown shade instead; black spots on the sides.
Conopia exitiosa, Ægeria apiformis.
1. Second annulet highest.
2. Crotchets on abdominal feet 6 to 9, in a row.
3. Brownish, with distinct, paler tubercles.....*Parharmonia pini.*
3. White, tubercles indistinct.....*Conopia pyri.*
2. Crotchets 9 to 14 in a row.
3. Slender; head small.....6. *C. tipuliformis.*
3. Stouter; head larger.
4. Lower ocellus developed, though light.
5. Crotchets normal .....*Alcathoë caudata, C. scitula.*
5. Crotchets very small, reduced.....*Bembecia marginata.*
4. Lower ocellus replaced by a pale spot.....*C. albicornis, C. rutilans.*
2. Crotchets 15 to 18 in a row (epicranial lobes meeting in a point).
C. pictipes, Podosesia syringæ.
2. Crotchets 18 to 22 in a row; epicrania broadly touching.
Memythrus 3-cinctus.
1. Third annulet higher than the others.....*C. acerni.*
Tubercles absent; annulets absent.....*Melittia satyriniformis.*

SYNOPSIS OF FOOD-HABITS OF THE LARVA[25]

Spring in trees:
Under bark of trunk some distance from the base or in the branches:
Maple .....*Conopia acerni.*
Maple .....*Conopia corni*
Apple, Pear .....*Conopia pyri.*

[25] Benutenmüller, William. Monograph of the Sesiidæ of America, North of Mexico. American Museum of Natural History. Mem. I[6] :215–352 (Reference on p. 229–230). 1901.

Dogwood, Oak, Chestnut ..... *Conopia scitula.*
Alder ..... *Conopia americana.*
Cherry, Plum, Juneberry ..... *Conopia pictipes.*
Pine and Spruce ..... *Parharmonia pini.*
Under bark at base of trunk or main roots:
Peach, Cherry, Plum, Apricot, etc ..... *Conopia exitiosa.*
In solid wood of trunks and branches:
Ash ..... *Podosesia syringæ.*
Oak ..... *Memythrus simulans.*
Poplar ..... *Memythrus dollii.*
Willow and Poplar ..... *Memythrus tricinctus.*
Willow ..... *Conopia bolteri.*
Willow ..... *Conopia albicornis.*
In solid wood at base of trunks and roots of trees:
Persimmon ..... *Sannina uroceriformis.*
Willow and Poplar ..... *Ægeria apiformis.*
Willow ..... *Ægeria tibialis.*
Boring in shrubs.
In solid wood:
Lilac ..... *Podosesia syringæ.*
Rhododendron ..... *Conopia rhododendri.*
In pith of stems:
Currant, Gooseberry ..... *Conopia tipuliformis.*
In roots:
Blackberry and Raspberry ..... *Conopia rutilans.*
Blackberry and Raspberry ..... *Bembecia marginata.*
Boring in vines and creeping plants.
In the stems:
Squash, Pumpkin, and other Cucurbs ..... *Melittia satyriniformis.*
In roots:
Grapevine ..... *Memythrus polistiformis.*
Clematis ..... *Alcathoë caudata.*
Herbaceous perennial plants.
In roots:
Strawberry ..... *Conopia rutilans.*
Heliopsis ..... *Conopia ithacæ.*
In borings of other insects:
Oak-gall (*Andricus cornigerus*) ..... *Conopia scitula.*
Oak-gall (*Andricus cornigerus*) ..... *Conopia rubristigma.*
Gall of *Saperda concolor* ..... *Conopia albicornis.*
Gall of *Saperda concolor* ..... *Memythrus tricinctus.*

1. *MEMYTHRUS* Newman

(*Sciapteron* Staudinger; *Paranthrene* Hübner, in part; *Tarsa* Walker; *Fatua* Henry Edwards; *Albuna* Henry Edwards)

Palpi upturned, normally with long hair below. Antennæ fusiform, normally bipectinate in male, the pectinations clavate. Tongue weak. Hind tibiæ with a little longer hair, but not tufted. Abdomen with a bunch-like anal tuft, and short spreading side tufts, or four pencils. Fore wing with R_3 sometimes shortly stalked, closure of cell oblique, hind wing with **mdcv** more oblique and longer than **ldcv**, and M_2 arising below middle of cell.

The two known American larva have brown-mottled heads with a black band across the face.

Key to the species

1. Fore wing outwardly transparent below R_5.
2. Antennæ pectinate ..... 1. *asilipennis.*
2. Antennæ serrate or simple ..... 8. *pyramidalis.*
1. Fore wing opaque, at least above M_1.
2. Fore wing entirely opaque outwardly.
3. Hind wings with an even, brown border (at least as broad as fringe), or mainly brown ..... 7. *dollii.*
3. Border in places not broader than fringe, but extended along branches of Cu as far as cell ..... 4. *scepsiformis.*
3. Hind wings transparent (except for the usual black fringe, terminal edge, and veins).
4. Palpi mostly black above; abdomen with short tufts ..... 6. *tricinctus.*
4. Palpi yellow above; abdomen of male ending in four pencils. 5. *polistiformis.*
2. Fore wing with a transparent area at anal angle.
3. Abdomen yellow toward apex ..... 2a. *simulans*, var. *luggeri.*
3. Abdomen with narrow yellow bands ..... 1. *asilipennis.*
3. Abdomen with second to fourth segments yellow, apex darker .. 2. *simulans.*
3. Abdomen orange ..... 3. *palmii.*

I. *Male antennæ bipectinate except on the club* (Tarsa Walker).

1. **M. asilipennis** Boisduval. Body, veins, and borders of wings dull brown; eddish in cell. Tegulæ rufous; segments of abdomen narrowly edged with yellow; gs orange; all wings of male and hind wings of female transparent; bar at end f cell oblique and rather heavy. Fore wings of female deep brown, with a ransparent triangle at anal angle and a streak at base. 32–40 mm. (female arger).

Larva in ash and alder roots.

New Hampshire and Minnesota to Florida and Texas. New York: Rochester unction, Buffalo, Staten Island; Brooklyn and Amagansett, Long Island.

2. **M. simulans** Grote. Blackish; face with two yellow stripes; front of palpi ellow; scape yellow; collar partly yellow; two yellow spots on tegulæ; and cutellum yellow. (In the type form the base of the abdomen is black, the next hree segments yellow, narrowly black at base of each, the fifth and sixth black, verlaid with loose greenish-looking yellow hair; and the apical tuft yellow and eddish. Legs yellow, becoming orange on tarsi, the tibiæ concolorous. Fore wing rown, strongly reddish in middle of wing, with outer third transparent below M_2 and ith two transparent streaks on basal half. Hind wing transparent. This extreme orm is little known and was described from Algonquin, Illinois, in June.) H 46:10.)

a. **M. simulans,** var. **luggeri** Henry Edwards. Similar; male with transparent reas often meeting below cell. Abdomen black at base, with a narrow stripe on econd segment only; the middle segments yellow on sides, and the tail solidly ellow; scape black, except below; fore tibia with considerable black hair above; iddle and hind tibiæ with small spots. 27–32 mm.

Late May to July. Larva in wood of black and red oaks; very rarely in white ak or chestnut. (The single specimen I have seen bred from chestnut has the ellow replaced with orange.)

The larva takes two years to reach maturity; the moth flying in the vicinity of ew York in odd-numbered years. Forms intermediate between variety *luggeri* nd the type are not rare.

Maine to Maryland. New York: Staten Island; Jamaica, Long Island (all f variety *luggeri*).

3. **M. palmii** H. Edwards. Similar to *M. simulans*, but usually with a larger extent of more orange-yellow on the body. Spot on tegulæ inverted-comma-shaped nearly reaching collar. Larva on oak.

New York City to Florida and the Pacific Coast. New York: Flatbush and Yaphank, Long Island.

4. **M. scepsiformis** H. Edwards. Dull black; antennæ in part, neck, palpi, legs in part, and base of hind wing rufous. Legs banded with black; second segment of abdomen with a yellow stripe. Border of hind wing very narrow, deeply extended in, along **Cu**, **1st A**, and **2d A**. 25–30 mm.

Male not seen; possibly a variety of *polistiformis*.

Maryland; Kansas; Texas.

5. **M. polistiformis** Harris. Brown, more or less iridescent with purple; with orange markings, as in *M. scepsiformis*, and also normally with orange bands on abdomen and almost wholly orange legs. A yellow band on fourth as well as second segment of abdomen; male with a transparent streak at base of fore wing and with abdomen ending in five pencils, as in Sannina. 22–40 mm. (**H 46**:11 ♂ 12 ♀.)

Larva boring in grape roots, and sometimes injurious.

Vermont to Minnesota, South Carolina, and Missouri.

II. *Male antennæ subpectinate and fasciculate; palpi hairy, but less so than in the simulans group.*

6. **M. tricinctus** Harris. Brownish; front of palpi and neck yellow; legs black and orange; abdomen with yellow bands on second, fourth, and sixth segments and in male on seventh also. Fore wing black with transparent streaks at base, the anal angle becoming transparent in rubbed specimens; hind wing transparent. Abdominal tuft short and massive. 25–28 mm.

June to July. Larva boring in willow and poplar branches.

Quebec to New York and Michigan. New York: Buffalo, Lancaster, Big Indian Valley, Karner, Long Island generally.

7. **M. dollii** Neumœgen. Thorax and wings deep brown; abdomen deep brown becoming more or less chestnut brown toward apex; the whole thorax and abdomen chestnut in variety **castaneus** Beutenmuller. Palpi dark. Fore wing a little transparent at base; hind wing with a broad brown border, somewhat diffuse, but with no special tendency to fill cell Cu_1. Legs dull orange; hind tibia dull fuscous below. Strongly variable both in size and markings. 20–38 mm.

Larva in solid wood of young poplars.

Southern New York; New Jersey; Pennsylvania; Illinois. New York: Brooklyn.

III. *Male antennæ somewhat servate, and less heavily fasciculate; palpi hairy; terminal tuft bifurcated* (Albuna *Henry Edwards*).

8. **M. pyramidalis** Walker. Fore wing transparent, with reddish and black-brown markings; margin extending about a third way into cell, rather wider toward apex, as in many Conopias. Bar at end of cell heavy and oblique. Border of hind wing narrower than fringe. Abdomen more or less striped with yellow. Palpi yellow in front. Legs black and yellow. 25 mm. (*montana* Henry Edwards.)

June to August.

Newfoundland and New York to the Pacific Coast. New York: Axton, Big Indian Valley; Brooklyn, and Bayshore, Long Island. The record for "*morrisonii*" from Watkins Glen doubtless refers to this species.

The female form **coloradensis** Henry Edwards, with a solid black body and legs, appears to be generally distributed with the species.

9. **M. fraxini** Henry Edwards (♀ *morrisonii* Henry Edwards), with solid black fore wings, abdomen, and legs, occurs east to Missouri. It may be distinguished by a bright red bar at the end of the cell.

2. *MELITTIA* Hübner

(*Trochilium*, in part)

Antennæ strongly flattened, with bristles along anterior edge; palpi like those of Memythrus, rather hairy. Hind tibiæ and tarsi heavily clothed with hair. Fore wing (fig. 224) with R_5 terminating below apex; hind wing with **m-cu** long, and set at an angle to base of **Cu**, so that the lower side of the cell appears curved. Larva boring in Cucurbitaceae; leaving the burrow to pupate in the ground. Segments not distinctly annulate; tubercles lost, and setæ minute.

The genus also occurs in Africa and India. Some western species are fully scaled.

1. **M. satyriniformis** Hübner. Black with green iridescence; palpi and fore coxæ with orange and white markings; fore wing transparent at base; hind wing transparent; tibiæ and hind metatarsi orange and black; the rest of tarsi black and white. 25–30 mm. (**H 46**:1.)

Often injurious to squash, pumpkin, and other Cucurbitaceæ; but the imago rarely seen. June to August.

Generally distributed, New York: Wells, Albany, New York City, Staten Island, Long Island.

3. *PODOSESIA* Möschler

(*Grotea* Möschler, not Cresson)

Head normal; antennæ fusiform and fasciculate in male; normal. Tongue strong; abdomen with a short terminal tuft in both sexes; hind tibiæ slightly lifted at the spurs; tarsi extremely long, with rough bristling hair the whole length, becoming erect scales on the metatarsus. Fore wing with R_5 terminating rather above the apex; hind wing with M_3 and Cu_1 stalked for a variable distance.

1. **P. syringæ** Harris. Deep brown, with more or less tawny, especially on palpi. An oblique yellow streak on side of abdomen at base, and a small lateral spot at middle; fore wings with purple iridescence, and often a red streak above R_3; hind wing transparent, yellow, with a narrow, diffuse, scaled edge. Tibiæ black and orange; tarsi yellow and black. 25–35 mm. (*Ægeria* Harris.) (**H 46**:17.)

Larva in solid wood of ash and lilac.

Canada to Colorado and Texas. New York: Albany, Long Island.

4. *SANNINA* Walker

Palpi scaled, somewhat roughly; antennæ lightly fasciculate. Tongue moderate. Hind tibia with rough hair, which is longer at the spurs; metatarsus only with rough raised scales like Podosesia. Abdomen of male ending in five pencils, the two lateral short and stout, the middle one slender and easily lost. Wings almost fully scaled (unlike the few Conopias which have nearly the same hind tibiæ); fore wing with R_5 running to outer margin, normal; hind wing with M_3 and Cu_1 rather long-stalked; cell short.

1. **S. uroceriformis** Walker. Deep blue-black; palpi and base of tegulæ sometimes orange. Fourth segment of abdomen red dorsally, with a narrow blackish center line. Wings opaque, except for a small transparent area at base between Cu and **3d A** of hind wing, the transparent spot in the female divided by a scaled area between **1st A** and **2d A**. 30 mm. (*quinquecaudata* Ridings). (**H 46**:7.)

Boring in roots of persimmon, well below the ground.

District of Columbia to Kansas, and south. New York: Albany.

5. *PARHARMONIA* Beutenmüller

(*Harmonia* H. Edwards, not Mulsant or Haswell)

Palpi almost straight, close-scaled; antennæ finely pubescent below. Abdome flattened and rough-haired at sides; hind tibiæ slightly tufted at spurs; R_5 run ning to apex, hind wing with **1dcv** long and oblique. Hardly distinct from Conopia but with the tibia less rough; our only species easily recognized by the orang under side of the abdomen. Larvæ boring in conifers, with the skin darker tha the tubercles.

1. **P. pini** Kellicott. Deep brown; fore wing slightly translucent; hind wing wit scattered smoky scales; the cell and cell **1st A** not specially darkened. Abdome brown above; fourth segment, above, sides, and under side mostly orange. 28 mm July. Larvæ boring in trunk of pine, usually in groups; a good deal of pitc oozing from the borings; the larva keeping an air-hole open through the pitc Pupa in a cell in the mass of pitch. On pitch pine, white pine, and spruce.

Canada and New Hampshire to New Jersey. New York: Oswego County, Buffal Portage, Ithaca, Hudson, Hastings Center.

6. *CONOPIA* Hübner

(*Sesia* Fabricius, in part; *Trochilium* Meyrick, etc., not Staudinger *Ægeria* Walsingham, not Beutenmüller, Meyrick, etc.; *Synan thedon* Hübner; *Pyrrhotænia* Grote; *Carmenta* Henry Edwards with *Sanninoida* Beutenmüller and *Chamæsphecia* Spuler)

Palpi normal, with rather rough bristling vestiture, sometimes flattened below Abdomen with terminal tuft of male moderate, spreading fanlike, simple, bifi as in Albuna, or spearhead shaped (*exitiosa*); when simple, sometimes with smal side-tufts; quite variable in appearance in most species, according to the stat of expansion, and so hardly usable for the subdivision of the genus. Hind tibia with well-marked bristly tufts at middle and end spurs; smooth-scaled betwee and at base; tarsi smooth-scaled. Fore wing with R_1 and R_2 typically free (fig 226), becoming concident near margin in *C. tipuliformis* (**Chamæsphecia**, fig. 227) R_5 running to rather above the apex; hind with **1dcv** more transverse tha in Parharmonia, often short. Several attempts to divide the genus have not bee very successful, especially as some of the aberrant species are only known in on sex. *C.* (*Sanninoida*) *exitiosa* is perhaps most distinct, and shows the strongest sexual dimorphism; but each sex can be closely matched elsewhere in the genus and there are no decided structural characters. **Chamæsphecia** represents a natura group, but many of the species have not been examined as to R_1 and R_2.

Key to the species

1. Fore wing wholly fuscous.
   2. Abdomen with a single red band.
      3. Hind wing almost wholly transparent.....2. *rubrofascia*
      3. Hind wing with black cell, and a shade between **1st A** and **2d A**. 1. *exitiosa*
   2. Abdomen with one or more yellow bands.....4. *pyralidiformis*
1. Fore wing fuscous, with a small hyaline spot.....5. *sanborni*
1. Fore wing with a larger patch, and cell also hyaline.....6. *rutilans*
1. Fore wing largely hyaline, with the space below **Cu** hyaline.

2. Terminal tuft red.
3. Interspaces near apex of fore wing light yellow.....8. *acerni.*
3. Margins of fore wing wholly black.....7. *corni.*
2. Terminal tuft black, or black and yellow.
3. Palpi and middle and hind tibiæ wholly bright orange.
4. Tarsus with metatarsus only orange; wing with smoky fringe only.
9. *fulvipes.*
4. Tarsus wholly orange; fore wing with fairly broad dark tip.
10. *saxifragæ.*
3. Hind tibiæ at least largely black or light yellow.
4. Abdomen with a single red transverse band.
5. Band on one segment; hind tibia with yellow band—(2.) *culiciformis.*
5. Band covering two segments.
6. Ground color of tip of fore wing red.....3. *bolteri.*
6. Tip of fore wing wholly black.....2. *rubrofascia.*
4. Abdomen more or less striped with yellow, or wholly black.
5. With seven hyaline interspaces toward margin, cell Cu_1 being hyaline.
6. Stigma black, narrow.
7. Sides of front yellow; vertex between antennæ black.
11. *pictipes.*
7. Sides of front concolorous, black; a yellow tuft between antennæ.....1. *exitiosa.*
6. Stigma largely red, contrasting.....12. *rubristigma.*
5. With six hyaline spaces, or fewer (Cu_1 scaled, with rare exceptions); border of fore wing broader.
6. Discal stigma concolorous.
7. Yellow bands on fourth and fifth segments of abdomen, both strong and equally strong.....14. *rhododendri.*
7. Fifth segment with a very weak band, or with none.
8. Hind metatarsus yellow; palpi yellow, or with some fuscous on upper side; abdominal tuft yellow at edges.
9. Abdomen with stripes on first and second segments nearly equal; also third and seventh of male, and sixth of female.
15. *bassiformis.*
9. Abdomen with first segment not striped; a very strong stripe on fourth segment; and a weaker stripe or none on sixth or seventh segment.....16. *scitula.*
8. Hind metatarsus black.
9. Abdomen with three strong yellow stripes, on second, fourth, and sixth segments of female, and on seventh of male.
17. *tipuliformis.*
9. Abdominal stripes weak or absent; never very strong on alternate segments.
10. Border extending more than half way in to end of cell.
20. *ithacæ.*
10. Border narrower.
11. Abdomen striped more or less with yellow, at least with a yellow bar on side of second segment; palpi largely yellow.....18. *pyri.*
11. Abdomen wholly black above; palpi yellow below in male; wholly black in female.....19. *albicornis.*
6. Discal bar contrastingly red, at least in large part.
7. Stripes on second to sixth or seventh abdominal segments, equal or nearly so; hind tibiæ yellow or largely so....21. *rileyana.*

7. Stripes on segment 4, or on 2, 4, and 6, much stronger; hind tibiæ largely black.
8. Metatarsus black; moth smaller.....13. *decipiens.*
8. Metatarsus yellow; larger.....22. *sigmoidea.*

1. **C. exitiosa** Say. Male with palpi black above and yellow below; antennæ black; a yellow tuft on vertex, as a rule; front black. Abdomen with variable fine yellow stripes. Hind legs black, narrowly yellow-ringed at spurs, and on segments of tarsi. Fore wing with border, aside from fringe, much narrower than an interspace; all cells below R_2 hyaline. Scaling wholly black. Anal tuft lanceolate, the scales narrowly white-tipped. Female with fore wings, costa of hind wings, including base of cell, and body and legs purple-black. A red band across middle of abdomen, typically covering one segment (but two in var. **edwardsii** Beutenmüller). 20–30 mm.; female larger (♀ *fitchii* H. Edwards).

July and August. Larva (the peach-tree borer) in the sap wood of peach, plum, and other Rosaceæ, usually close to the surface of the ground; often injurious in peach orchards. Pupation in a cocoon, rarely outside the burrow.

Generally distributed in the range of its food plant. New York: Buffalo, Ithaca and vicinity, Albany, New Windsor, Staten Island; Brooklyn, and Jamaica, Long Island. Var. *edwardsi* Beutenmüller is commoner than the typical female about Ithaca and also occurs at Phelps (Ontario County).

In aberration **luminosa** Neumœgen, the head, most of the abdomen, and the costa, and part of the veins of the wings are bright golden yellow.

In the remaining species the sexual dimorphism, though often marked, is never as striking as in *exitiosa.*

2. **C. rubrofascia** H. Edwards. Blackish; mid-tarsi and last four segments of hind tarsi whitish; abdomen with two middle segments dull red. Fore wing of male hyaline, with blackish discal bar, and border extending halfway in to cell, leaving five hyaline cells. Hind wing with only the extreme edge blackish; the cell all hyaline. Anal tuft lanceolate. 22 mm.

South Carolina; Georgia; also very probably in our area. New York: reported from New York City.

C. culiciformis Linnæus, from birch, and the very similar **C. americana,** from alder, are definitely known only from the Rocky Mountains to the Pacific Coast.

3. **C. bolteri** H. Edwards. Almost like male of *C. rubrofascia*; tip of fore wing red between veins; hind tarsus wholly blackish on outer, and paler on inner, side; sexes similar. 15–21 mm.

Larva in solid wood of willow, well above ground.

Illinois. New York: Ithaca, Big Indian Valley, Mosholu.

4. **C. pyralidiformis** Walker. Blackish. Palpi yellow; fore wing obscurely hyaline at base and beyond cell in male, but not forming distinct spots; wholly opaque in female; hind wing like *C. rubrofascia.* Body fuscous, with a broad yellow band on fourth segment, and fine bands on second and sixth or seventh segments sometimes (usually in Illinois) with the three bands nearly equal. Legs blackish; a yellow spot at upper spurs, and last four joints of tarsus pale. Tuft as before, or spread fanlike (*nigella* Hulst).

Long Island, New York, to Illinois and Texas. New York: Fairport, Batavia, Staten Island; Amagansett and Woodhaven, Long Island.

5. **S. sanborni** H. Edwards. Blackish; palpi largely yellow; fore wing with a nearly round hyaline spot beyond cell, covering three cells, and a slight transparency at base. Border of hind wing rather wider than usual. Body with yellow stripes on segments 4 and 6. Female type only known; without hind legs. Possibly an aberration or a northern form of *pyralidiformis.*

Massachusetts.

6. **C. rutilans** H. Edwards. Palpi, occiput, and two stripes on thorax yellow. Segments 2 and 4 of abdomen with posterior half yellow, 6 a little more nar-

rowly striped, and the other segments narrowly striped if at all. Tuft, when perfect, bilobed, Albuna-like; largely black. Hind legs yellow, black between spurs of tibiæ. Fore wing normally with small hyaline areas in and beyond cell, fully scaled below cell in many females, and always with the outer part of the cell Cu fully scaled. Scaling of fore wing mixed black and yellow. Male usually with more hyaline and black, and less yellow. Border of hind wing wider than usual, with yellow and red scales. 15–22 mm. (*lupini, washingtonia, perplexa, hemizoniæ, impropria* Henry Edwards). (**H. 46**:31 ♂, 32 ♀.)

Light specimens are very close to *C. bassiformis* var. *sexfasciata*, but differ in that the stripe on the first segment is much weaker than on the second. *Scitula* may be distinguished by the much narrower black bar at the end of the cell (it is as wide as high in *rutilans*, and more than twice as high as wide in the *scitula* group); *ithacæ* may be recognized by the black hind legs.

Larva in roots of Veronica, blackberry, raspberry, and strawberry; probably a general feeder.

Nova Scotia to New York and the Western States; doubtless also in intermediate localities in Canada.

7. **C. corni** H. Edwards. Black, slightly marked with yellow; hind tibia with a black patch; anal tuft contrasting, bright red, with a black center, often spread fanlike. Fore wing with scaling black, border extending only a third way in toward cell. 20 mm.

Larva in small branches on silver and red maple, causing a gall-like swelling.

Massachusetts to Parry Sound, Ontario, and western Pennsylvania. New York: Sharon Springs, Karner, Staten Island; Brooklyn and Newtown, Long Island.

8. **C. acerni** Clemens. Head and body shading from light tawny to straw yellow and light fuscous; anal tuft wholly light red, normally paler than in *C. corni*. Fore wing with border light yellow between veins (rarely with only a few yellow scales) extending two-thirds way in to the large black discal bar; hind wing also with discal bar large. 25 mm. (*acericolum* Germar).

Larva boring under bark of the larger branches and trunk of maple. Moth in June and July.

Montreal, Canada, to Long Island, New York, western Pennsylvania and Illinois. New York: Buffalo, Rock City, Ithaca, Ilion, Speculator, Schenectady, Albany, Staten Island; Brooklyn and Newtown, Long Island.

9. **C. fulvipes** Harris. Anal tuft lanceolate; hind tibiæ rough-hairy the whole length and only slightly more so at the spurs; transitional to Sannina. Black; fore wing with terminal edge, only, scaled; a few red scales beyond discal dot. Front of palpi, all tibiæ, and most of hind metatarsi orange. An orange band on under side of abdomen. 22 mm.

Hymers, Ontario, to Massachusetts. New York: Big Indian Valley, Catskills.

10. **C. saxifragæ** H. Edwards. Similar to *S. fulvipes;* border of fore wing extending in a third way to cell; middle and hind tarsi almost wholly orange; abdomen apparently solid black. 20 mm. (*henshawi* H. Edwards).

Labrador; Colorado.

11. **C. pictipes** Grote and Robinson. Sometimes like male *exitiosa*, except as noted in the key; typically smaller, and with outer half of most of the scales in the anal tuft yellow; palpi more yellow, R_3 and R_4 of fore wing normally more shortly stalked. Female like male, but usually with hind tibiæ and terminal tuft almost wholly black. 15–25 mm. (**H 46**:24.)

General in June. Larva usually under bark of trunk and large branches of cherry, plum, June-berry and other Rosaceæ; also on chestnut (*castaneæ* Busck). Not so common on peach nor so injurious as *C. exitiosa*, but much confused with it.

New York: Buffalo, Ithaca, Catskills, Schenectady, Albany, Poughkeepsie, Hastings Center, New York City, Staten Island, Brooklyn.

12. **C. rubristigma** Kellicott. Palpi black, the scaling in front yellow; antennæ black, and more strongly clubbed than usual; abdomen irregularly striped, the

stripes on base and fourth segment strongest; and tuft black and yellow, more broadly spreading than usual. Legs contrastingly banded with black and yellow, the hind metatarsus variable in proportions. Fore wing hyaline, like male *exitiosa* and *pictipes*, but with the black costal edge broader, because of the wider spacing of the costal veins; discal bar rather thick, and almost wholly bright red. 15 mm.

Larva inquiline in oak galls.

New York to Illinois. New York: Mosholu, Brooklyn.

13. **C. decipiens** H. Edwards. Similar to *C. rubristigma;* border of fore wing extending in a third way to cell, yellow between the veins. 15 mm. Probably a variety of *C. rubristigma* or its female. (*nicotianæ* H. Edwards, *imperfecta* H. Edwards.)

Mosholu, New York; Colorado; Texas.

14. **C. rhododendri** Beutenmüller. Palpi black above, straw yellow below; body black, with strong transverse stripes on segments 2, 4, and 5; anal tuft, in male, large and mostly black. Legs blackish bronze, pale at spurs and joints. Fore wing with scaling almost all black (a few yellow scales); outer margin extending two-fifths way in to cell, leaving five hyaline spots; discal bar narrow, black. 9–13 mm. Our smallest Sesian.

Larva on Rhododendron.

New York; Pennsylvania. New York: Ithaca, Brooklyn.

15. **C. bassiformis** Walker. Purple-black; palpi yellow with some dark on upper side of terminal segments; vertex with yellow line; female antennæ, as generally in the following species, with the apical half largely white, but extreme tip black. Abdomen with fine yellow stripes on segments 1 to 4 and typically on 6 and 7; the anal tuft narrowly edged with yellow; in the female, with the stripes on 4 and 6 heavy, on 3 and 5 light. Hind tibiæ yellow below, often mostly black above; the tarsi mostly yellow. Fore wing with border broad, and more or less yellow-scaled; typically with five hyaline cells. 20–25 mm. (*lustrans, eupatorii,* etc., H. Edwards). (**H 46**:21.)

In variety **sexfasciata** H. Edwards (*bollii* H. Edwards) there are only four hyaline cells, and the outer border is broader. Variety **consimilis** H. Edwards has segment 6 as well as segment 5 without yellow.

August; September. Larva in stem and root of Eupatorium.

Massachusetts to Wisconsin and Texas. New York: Tuckahoe, Staten Island; Sea Cliff, Long Island.

16. **C. scitula** Harris. Antennæ and palpi as in *C. bassiformis;* abdomen with the yellow band on segment 4 typically much heavier than the others, often covering the whole segment; segment 2 with heavy band, but those on 1 and 7 very weak or absent. Hind tibiæ yellow, with a black band between spurs; metatarsi contrasting, yellow. Wings as in *C. bassiformis.* 15 mm. (**H 46: 29.**)

June and July. Larva reported from under bark of Cornus, oak, hickory, chestnut, Cratægus (Wellhouse), and in oak galls; but perhaps mixed with other species,—certainly from Andricus galls on oak.

Distribution uncertain; much confused with *pyri, bassiformis,* and other species in collections. Glen House, New Hampshire. New York: Hudson, Long Island.

17. **C. tipuliformis** Linnæus. Palpi black on outer face, yellow within. Abdomen with bands on segments 2, 4 and 6, and on 7 of male, that on 6 of male weak; anal tuft black. Hind legs black, with yellow at spurs and joints only. Fore wing like that of *C. bassiformis.* 20 mm. (**H 46: 26.**)

June. Larva in pith of currant and gooseberry stems; rarely injurious. This appears to be the only northern species which belongs to Chamæsphecia.

Generally distributed. New York: Plattsburg, Buffalo, Ithaca, Kendall, Albany, Staten Island; Pinelawn, Long Island.

18. **C. pyri** Harris Black; palpi yellow, with outer side mostly black; neck black; abdomen with a slender yellow line above, expanding on lower part of side into a patch which reaches base of body; segment four of abdomen narrowly yel-

ow above and broadly so, below. Legs black; yellow at spurs and joints. Fore wing with border reaching about a third way in to cell; more or less yellow-scaled; discal bar narrow; black. Small, expanse typically about 12 mm., but quite variable in size. (*kœbeli* H. Edwards). (**H 46**:25, enlarged.)

May; late July. Larva boring under bark of trunk of apple, pear, etc.

White Mountains, New Hampshire, to California. New York: Honeoye Falls, Buffalo (Kellicott), Ithaca, Staten Island, Brooklyn.

19. **C. albicornis** H. Edwards. Black. Neck narrowly yellow; palpi black, yellow in front in male, but usually wholly black in female; face as in *pyri*. Antennæ black in male, with a white bar in female, as in related species. 15 mm.

June and July. Larva in solid wood of willow and poplar; also in galls.

Generally distributed. New York: Catskills, Karner, New York City, Brooklyn.

20. **C. ithacæ** Beutenmüller. Fuscous (probably black when fresh); palpi black below, at least in female; border of fore wing extending half way in to cell in male, and farther in female, leaving four or five hyaline spots; legs with a little pale at spurs and segments; abdomen apparently wholly fuscous (type lot only seen, all of them in bad condition). 15–20 mm.

End of June to early August. Larva in Heliopsis. Pupa in the ground.

Pennsylvania. New York: Ithaca.

21. **C. rileyana** H. Edwards. Antennæ of male blackish, of female reddish at base; palpi yellow, the outer face black in male. Fore wing with four to six transparent cells beyond the discal bar, which is bright orange red outwardly. Inner margin of fore wing also with red scales. Hind tibiæ yellow, black between spurs; metatarsi yellow; abdomen with yellow stripes on all but first segment. Border of fore wing quite variable, linear in var. **hyperici** H. Edwards. 20–30 mm.

In female aberration **brunneipennis** H. Edwards, the border reaches more than half way to the cell, leaving only three hyaline spaces.

July and August.

District of Columbia to North Carolina, and west.

22. **C. sigmoidea** H. Edwards. Palpi mostly yellow; hind tibiæ with black outer side; metatarsi yellow, contrasting with tibiæ and rest of tarsus; abdomen with bands stronger on alternate segments; the terminal tuft narrowly tipped with yellow, as in *exitiosa*. Fore wing with discal dot red, largely mixed with black; border not reaching halfway to cell; sometimes very narrow. 20 mm.

August. Larva in stems of black willow. A seaside species.

Walpole, New Hampshire, to Long Island, New York. New York: Amagansett, Long Island.

7. *ÆGERIA* Fabricius

(*Sphecia* Hübner; *Trochilium* auct., Hübner, in part)

Palpi as usual, hairy below toward base; male antennæ unipectinate and laminate below; female antennæ simple. Tongue weak, completely covered by palpi when coiled; hind tibiæ loose-hairy, without tufts at spurs; abdomen with a small short tuft. Fore wing normal (fig. 225); R_5 running to outer margin, M_2 and M_3 more curved, and less widely separated from Cu_1 than usual; hind wing with M_3 and Cu_1 shortly stalked or rarely connate; the genus distinguishable from Memythrus in the latter case, by the erect discocellulars of the fore wing, and the strongly oblique and very long **ldcv** of the hind wing.

1. **Æ. apiformis** Clerck (The hornet moth). Sides of face, front of palpi, sides of back of head, vertex, front half or more of tegulæ, and metathorax, yellow; the rest of head and thorax dark brown. Abdomen banded with blackish and yellow; with segments two and four normally with more black than the others. Tibiæ and tarsi more orange. Wings transparent, fore wing scaled along costa to middle of cell R_4, and with slight streaks in middle of a few lower cells; otherwise with

scales on edges and veins only. Scaling brown; discal bar red in part. 30–40 mm. (H 46:8.)

Larva boring in base of trunks and roots of poplar and willow.

Europe; various stray records in United States (Michigan, Syracuse, New York, etc.); seen only from Long Island, New York, and Nevada.

2. **Æ. tibialis** Harris. Similar to *Æ. apiformis;* yellow on vertex more limited; tegulæ with front quarter only, yellow, and part of that covered by collar; with a strong yellow stripe along dorsal edge. Fore wing scaled above R_2 only. Rarely, with thorax and abdomen more extensively black; with narrow yellow lines only.

June to July. Larva like that of *Æ. apiformis.*

Montreal, Quebec, and New York to the Pacific Coast. New York: Plattsburg, Goat Island (Kellicott).

8. *ALCATHOE* H. Edwards

Palpi rough scaled only; male antennæ lightly fasciculate; tongue weak. Venation normal, except for loss of one radial. Hind wing with ldcv erect. Hind tibia with a heavy tuft at end, and an equally large tuft on metatarsus. Abdomen of male with a long hairy process, as long as the abdomen, besides short side tufts.

1. **A. caudata** Harris. Black. Fore wing scaled, except in and below cell in male; hind wing transparent, with a small black spot on mdcv. Antennæ, palpi, and neck orange; hind legs orange, with a black tibial tuft. Long process on tail orange; side tufts black. Female with hind legs black, except outer joints of tarsus. 25 mm.

June to August. The larva bores in the crown of clematis.

Canada to Florida, west to Michigan. New York: New York City, Brooklyn and Newtown, Long Island.

In variety **walkeri** Neumœgen, the antennæ are mostly black, the palpi are black, and also the whole of the hind legs and the process on the abdomen.

Long Island, New York.

9. *BEMBECIA* Hübner

Antennæ bipectinate in male, with oblique pectinations, and no terminal tuft (fig. 231); palpi with hair below. Abdomen stout, rather cylindrical, with short terminal tuft and a well-marked dorsal tuft on segment 3. Hind tibiæ loose-hairy.

Fore wing normal (fig. 229) except for loss of one **M**; cell square at end; hind wing with M_3 and Cu_1 stalked half way to apex; ldcv transverse and more than twice as long as mdcv. Tongue moderate.

1. **B. marginata** Harris. Body black; palpi, neck, some markings on thorax, and a stripe on each segment of abdomen yellow; the abdomen becoming solid yellow at rear; fore wing with a mixture of brown and rusty scales, leaving cell and anal space clear, as well as three interspaces toward margin; the boundaries of the scaled areas not quite sharp. Hind wing with brown fringe only. Male 25 mm.; female mostly over 30 mm.

August to mid-September. The larva in blackberry and raspberry, at first in roots, then working up into the canes.

Generally distributed. New York: Wilmington, Lancaster, Ithaca, Staten Island, Long Island.

In variety **albicoma** Hulst the yellow is very pale cream color, except on the hind legs, where it is as dark as usual. I have seen it in recognizable condition from Big Indian Valley and Brooklyn.

superfamily TORTRICOIDEA

Moths varying from very small to very large, some exotic Cossidæ being the heaviest known moths. Head with short erect hair, usually rough, but not high and bristling as in the Tineidæ; in a few exotic genera of Tortricidæ smooth-scaled. Ocelli usually present. Antennæ as in the Yponomeutoidea; palpi characteristic (figs. 240–243, 271–283), more or less rough, projecting forward, the second joint usually rough-scaled or with a rough triangular tuft, and the third fusiform, porrect, often short, and rarely as long as second. Palpi in a few forms (for instance, fig. 272) upturned more as in the Tineoid series; but then never reaching the vertex and always with the third joint short. Palpi sometimes with roughly bristly vestiture, but never with the definite bristles of the Tineidæ. Maxillary palpi rudimentary or absent; the pilifer large, and concealing them in any case. Tongue usually developed, but often absent. Thorax with vestiture varying from simple scales to deeper spatulate scales or hair; the vestiture of the legs similar. Hind tibiæ hairy, even when the legs otherwise are scaled. Spurs weak and sometimes lost in the Cossidæ. Upper spurs of hind legs well below middle. Fore wing with all veins preserved or with a single vein lost; ample; $\mathbf{R}_5$ running to outer margin with rare exceptions, and free or stalked with $\mathbf{R}_4$; the other veins usually free; accessory cell distinct, with its broad side resting on discal cell; the separating vein often weak, but strong in the Cossidæ and other primitive forms; **1st A** distinct, at least at margin, in the Tortricidæ and Cossidæ, but not in the Phaloniidæ and Carposinidæ; complete in the Cossidæ; and, in some western and exotic Cossidæ, connected with **2d A** by a crossvein; **2d A** usually forked at base. Hind wing nearly as wide as fore wing but short in the Cossidæ; **Sc** and **R** separate, or connected by $\mathbf{R}_1$; often differing in closely related species. **R** and $\mathbf{M}_1$ often stalked; $\mathbf{M}_3$ and $\mathbf{Cu}_1$ often stalked or united, but with two veins lost only in Carposina; **1st A** as in fore wing, always free; **2d A** forked at base, but less markedly than in the Choreutis group.

The wings rarely if ever show the typical macro maculation with ante- and postmedial lines and orbicular and reniform spots; in the lower forms the marks are usually a system of irregular spottings and anastomosing striæ.

Egg normally of flat type, that of the Cossinæ upright. In all the families, the larva typically is boring; but many of the Tortricidæ have come to live externally, protected in some sort of shelter, usually of a rolled or folded leaf, whence the name leaf-

rollers. The larvæ (figs. 245, 284–287) never have conspicuous markings, except for the shields and tubercles. Head always exposed and fully chitinized, with normal mouth-parts (as in all the higher groups). Mandibles tending to point more forward than those of external feeders, but not different in structure. Front extending from one-fourth to three-fourths way to vertex; adfrontals almost always touching the vertex, sometimes very large; ocelli normal. Prespiracular wart with three setæ. Abdomen with setæ **i** and **ii** well separated, and **iv** and **v** approximate usually on one tubercle; prolegs with hooks in a complete circle, which is often broken in front and back,— except in a couple of Cossidæ; often with tubercles **ii** of ninth segment of abdomen approximated or united in mid-dorsal line, and often with a specialized multiple supra-anal spine. Many species are injurious as borers or external feeders,— probably a larger proportion than of any other superfamily.

Pupa of a normal incomplete type, with segments 3 to 6, and 7 of male, movable, with two rows of spines on each segment, as in the higher Tineoidea and Ægeriidæ. Head often with a cocoon-breaker; prothorax convex and wider than dorsal headpiece; maxillæ distinct, not divergent as in the Hepialidæ, but sometimes almost as small, and completely separated by the labial palpi, which are always exposed. Mentum well developed. Maxillary palpi distinct, separated by a suture; but in Zeuzera, at least, remaining with maxillæ on dehiscence.

Antennæ varying, following their character in the adult; rarely if ever as long as wings. Fore femora exposed. Cremaster of various types.

The four families are quite clean-cut; in fact, are united mostly by the combination of specialized micro larva with typical incomplete pupa. The Eucosminæ (Olethreutinæ) are often made a separate family, but have no clean-cut characters to distinguish them from the Tortricinæ, though certainly a well-marked group in the imago. Several workers separate the Zeuzerinæ also as a family Zeuzeridæ. In this case intermediate forms are rarer if they exist, and the separation is very possibly justified; it has not generally been made by American workers.

Family. 28. **TORTRICIDÆ**

(With *Eucosmidæ, Grapholithidæ, Epiblemidæ, Olethreutidæ*)

Ocelli present (so far as looked for); antennæ rarely pectinate (never in our species); the scaling confined to dorsum of antenna, but the outer row stronger and longer than the inner; ventral surface pubescent, more strongly so in male; palpus moderate, upturned to middle of front, or rough and porrect, often triangular; tongue present, usually rather

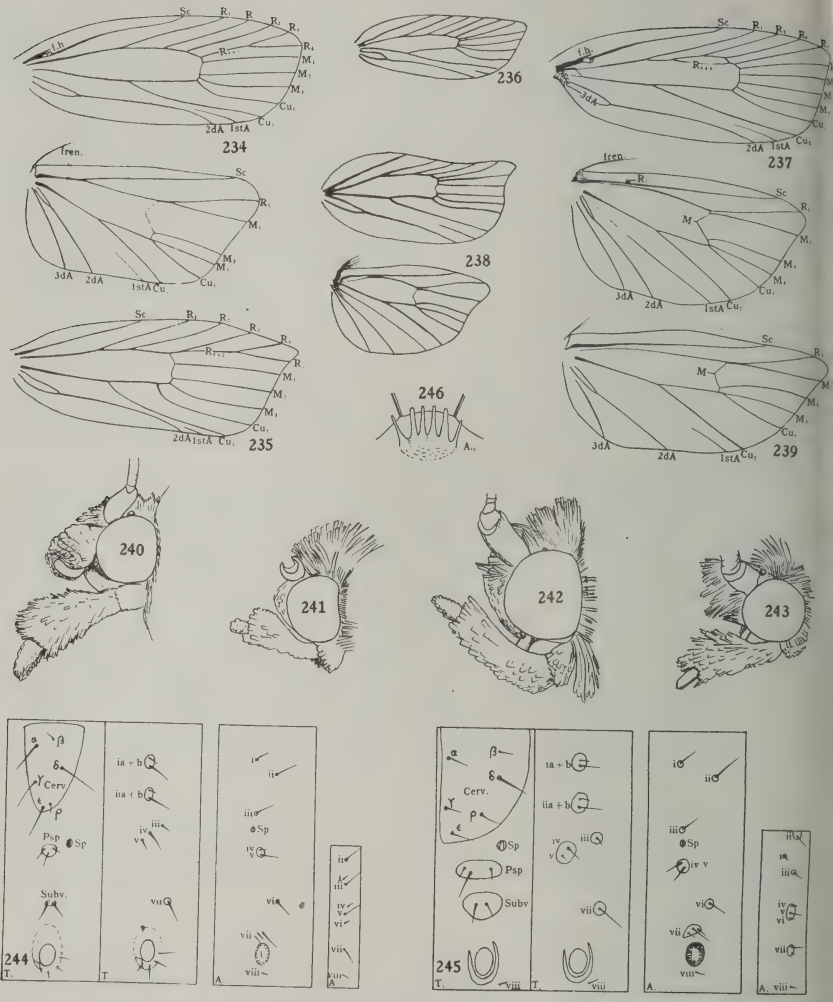
ak. Body slender; hind tibia hairy, the others smooth-scaled. Wings oad, the fore wing often abruptly widened at the base, giving the mily its name of "bell moths," from the shape of the moths with eir wings folded. Fore wing (fig. 252) with R_5 rarely running to sta; base of **M** simple (representing M_3) crossing the cell obliquely, , more rarely, absent; accessory cell often ill defined; Cu_2 arising ro-thirds way out on cell, or less; distant from Cu_1; **1st A** free and eak at base, absent in a few reduced forms. Hind wing ample, with inge markedly widened at anal angle; scaling soft.

Egg flat. Larva (figs. 244–246, 284–287) with hooks of prolegs ultiordinal, except in a few reduced forms; ninth segment of abdo- en with tubercles **ii** usually united, always approximate; **iv** and **v** n abdomen obliquely or vertically placed; **vii** of seventh segment, f two or more setæ. Pupa with hooked spines either on last segment, r on the specialized cremaster, tongue well developed; maxillary palpi eparating from tongue on dehiscence; antennæ reaching nearly to tip f wings.

This is one of the large world-wide families, and very nearly repre- ents one of Linnæus' subgenera of Phalæna (Tortrix). Several of the enera recognized here are based on secondary male characters only and ave been rejected by Walsingham and Durrant, and others. Our series f forms is so unwieldly and other clean-cut characters are so scarce hat I have retained them here with some modifications. The venational haracters vary a little, and in some cases a series will be necessary to nake sure that a specimen is not a venational freak. The costal fold in he male, when it occurs, is often very tightly closed, especially in Eucosma and Epiblema, and is easily overlooked; when it becomes rudi- nentary, as in some Archips, it is usually open and more easily seen.

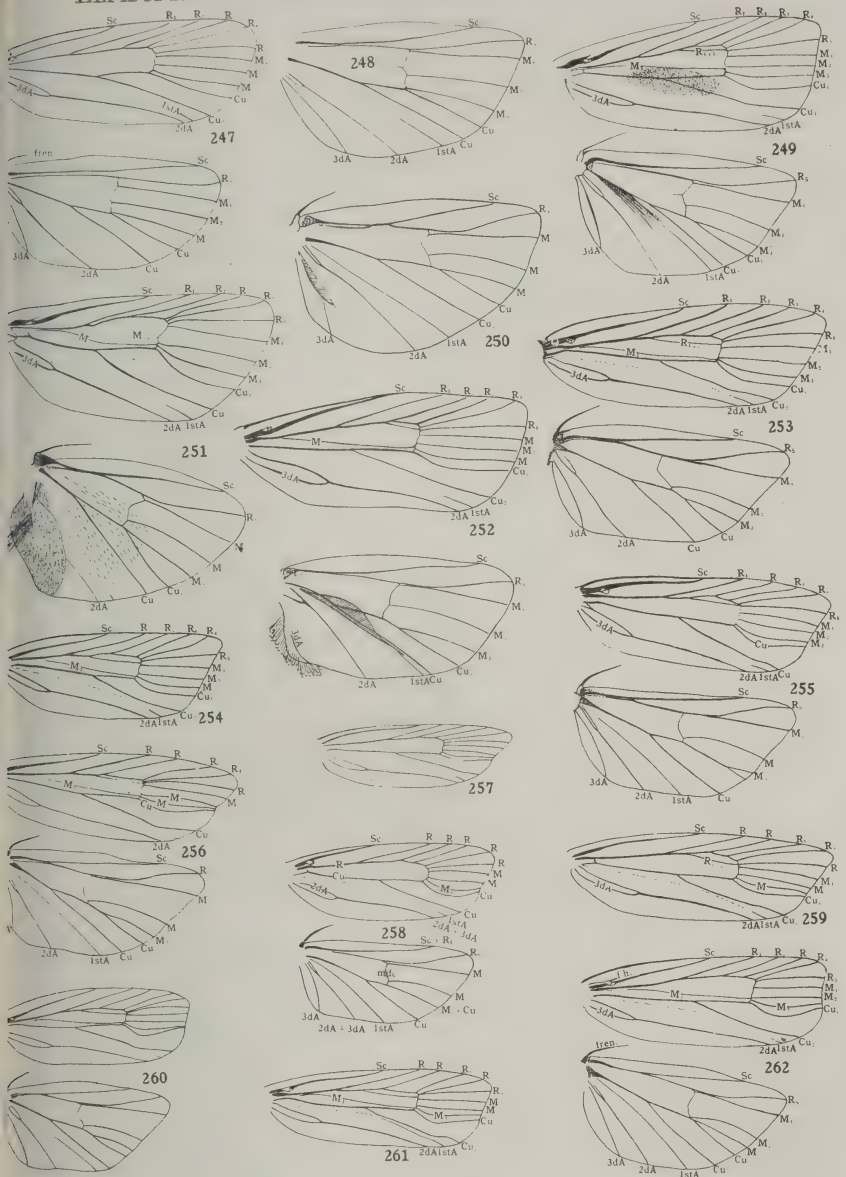
Key to genera; imago

1. No fringe on base of **Cu** of hind wing (often with loose hair below **Cu**, or with a fringe on base of **2d A**).
2. Fore wing with R_4 and R_5 stalked half way to apex; R_5 running to outer margin (fig. 235).
3. R_3 arising from the same stalk ..... 36. **Cœlostathma.**
3. R_3 arising from cell ..... 37. **Adoxophyes.**
2. R_4 and R_5 very shortly stalked or free.
3. M_3 and Cu_1 of hind wing united ..... 39½. **Tortricodes.**
3. M_3 and Cu_1 separate, rarely stalked.
4. Fore wings with R_5 running to costa; apex more or less marked (fig. 236) ..... 39. **Peronea.**
4. Fore wings with R_5 running to outer margin, or to the bluntly rounded apex (fig. 237).
5. Palpi ascending (fig. 242); hind wing with **R** and M_1 approximate at base.
6. Thorax with posterior crest; M_3 and Cu_1 of hind wing usually slightly separate at origin ..... 41. **Harmologa.**



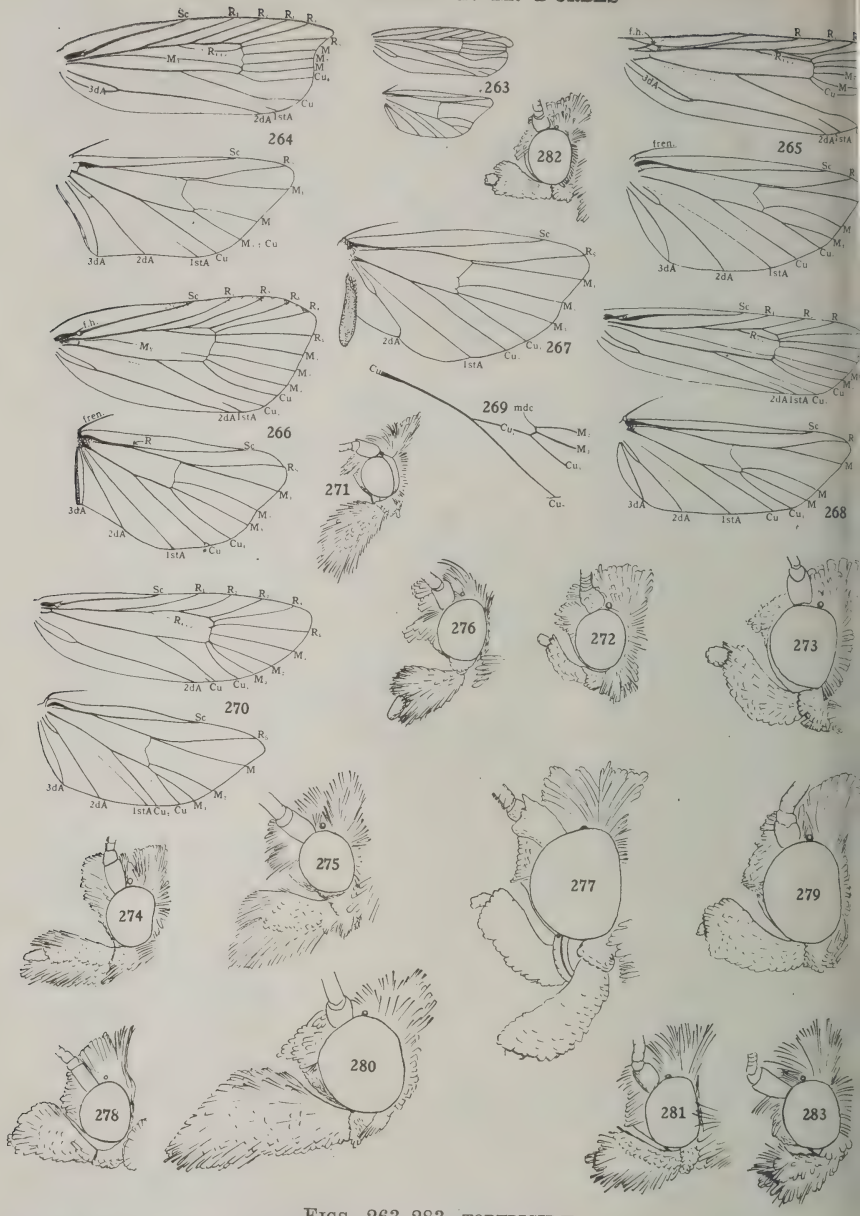
FIGS. 234–246. TORTRICIDÆ

234, *Sparganothis sulfureana*, venation; **235**, *Cœlostathma discopunctanum*, venation of fore wing; **236**, *Peronea* species (Europe), venation of fore wing; **237**, *Tortrix pallorana* ♂, venation; **238**, *Archips podana* ♀ (Europe), venation; **239**, *Cnephasia virescana*, venation of hind wing; **240**, *Sparganothis* (*Cenopis*) *diluticostana*, ventro-lateral view of head of male with palpi drawn down, showing the frontal vestiture characteristic of the subgenus; **241**, *Peronea variana*, side view of head; **242**, *Archips rosaceana*, head; **243**, *Tortrix dohrniana* (Europe), head; **244**, *Peronea* species, seta map of larva; **245**, *Archips magnoliana*, seta map of larva; **246**, *Archips magnoliana*, dung fork of larva



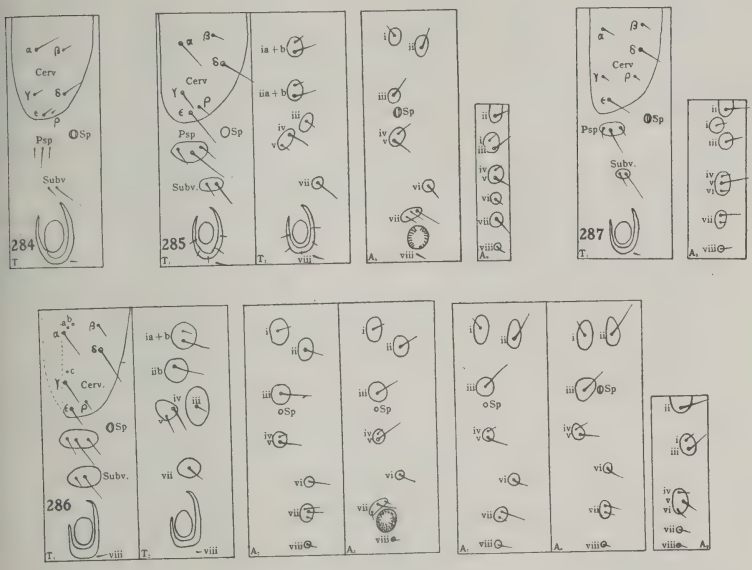
FIGS. 247–262. TORTRICIDÆ

247, *Hemimene bittana*, venation; **248**, *Laspeyresia interstinctana*, venation of hind wing; **249**, *Carpocapsa pomonella* ♂, venation and sex marks; **250**, *Ecdytolopha insiticiana* ♂, venation and sex pouch; **251**, *Gymnandrosoma punctidiscanum* ♂, venation and sex marks; ♂, venation and sex marks; **253**, *Charlotta ratzeburgiana*, venation; **254**, *Epinotia nanana*, ♀, venation of fore wing; **255**, *Thiodia parmatana*, venation; **256**, *Exentera spoliana*, venation; **257**, *Thiodia striatana*, venation of fore wing; **258**, *T. raracana*, venation; **259**, *T. formosana*, venation; **260**, *Gretchina deludana*, venation; **261**, *Exentera maracava*, venation; **262**, *Episimus argutanus*, venation.



FIGS. 263–283. TORTRICIDÆ

263, *Rhopobota ilicifoliana*, venation; **264.** *Anchylopera nubeculana* ♂, venation and anal fold; **265,** *Epiblema scudderiana* ♂, venation and costal fold; **266,** *Olethreutes fuscalbana* ♂, venation and anal fold; **267,** *Cymolomia* species ♂, venation and lobe; **268,** *Bactra lanceolana*, venation; **269,** *Polychrosis* species, cubital stem and branches of hind wing; **270,** *Rhyacionia bushnelli*, venation; **271,** *Hemimene dana*, side view of head; **272,** *Laspeyresia caryana*, head; **273,** *Carpocapsa pomonella*, head; **274,** *Gypsonoma fasciolana*, head; **275,** *Thiodia aspidiscana*, head; **276,** *Charlotta ratzeburgiana*, head; **277,** *Ecdytolopha insiticiana*, head (the left palpus drawn down); **278,** *Epiblema ocellana* (Europe), head; **279,** *E. scudderiana*, head, **280,** *Encosma dorsisignatana*, head; **281,** *Olethreutes bipartitana*, head; **282,** *Polychrosis viteana*, head; **283,** *Rhyacionia comstockiana*, head.



FIGS. 284–287. TORTRICIDÆ

284, *Laspeyresia interstinctana*, seta map of prothorax of larva; **285,** *Carpocapsa pomonella*, seta map; **286,** *Tmetocera ocellana*, seta map; **287,** *Anchylopera rubeculana*, seta map.

6. Thorax smooth-scaled; M_3 and Cu_1 connate or shortly stalked. **44. Archips.**

5. Palpi porrect, rough above as well as below (fig. 243).
6. Hind wing with R and M_1 stalked (fig. 239); thorax normally smooth **40. Cnephasia, 42. Eulia.**

6. Hind wing with R and M_1 approximate.
7. Fore wing with tufts of scales ..... **38. Argyrotoxa.**
7. Fore wing smooth-scaled.
8. Male antennæ with notch near base ..... **45. Pandemis.**
8. Male antennæ not notched.
9. Thorax with posterior crest ..... **42. Eulia (Argyrotænia).**
9. Thorax without crest.
10. Veins nearly evenly spaced at margin of fore wing (fig. 237) ..... **43. Tortrix.**
10. M_1 and M_2 of fore wing somewhat approximate at tip. **2. Laspeyresia (*lautana*).**

1. Cu of hind wing with a fringe or tuft of hair on upper side at base, besides the scattered hair below Cu.[26]
2. Fore wing with R_4 and R_5 stalked.
3. Apex of fore wing subfalcate with a notch just below it, above M_1 (fig. 263) ..... **11. Rhopobota.**

[26] For females of this group, see supplementary key, page 384.

3. Apex of fore wing not falcate.
4. **M_2, M_3,** and **Cu_1** closely approximate at margin of fore wing (like fig 260).
5. Fore wing with raised scale-ridges or tufts.....22. **Gretchina**
5. Fore wing smooth-scaled.....23. **Exentera** (and a few **Epinotia**)
4. **M_2, M_3,** and **Cu_1** evenly spaced at margin.
34. **Sparganothis,** 35. **Amorbia** ♀
2. Fore wing with **R_4** and **R_5** completely united; 11 veins only.
3. **M_2, M_3,** and **Cu_1** approximate at margin of fore wing.
4. Hind wing with **M_3** and **Cu_1** completely united.....19. **Suleima**
4. **M_3** and **Cu_1** stalked.
5. Costal fold present.....18. **Sonia.**
5. Costal fold absent.....12. **Kundrya.**
3. **M_2, M_3,** and **Cu_1** not approximate at margin.....35. **Amorbia** ♂
2. Fore wing with **R_4** and **R_5** separate or connate.
3. Hind wing with **R** and **M_1** remote at origin (fig. 247), more than half as far apart as **M_2** and **M_3** when the latter are also remote.
4. **R** separate from **Sc** in hind wing; eyes a little reduced, with a scaled band behind them (fig. 271).....1. **Hemimene.**
4. **R** of hind wing becoming coincident with **Sc**.....1½. **Pammene.**
3. Hind wing with **R** and **M_1** closely approximate or stalked.
4. Fore wing falcate, with a distinct point between **R_4** and **R_5**, broadly concave below.[27]
5. Hind wing with **M_3** and **Cu_1** stalked, rarely separate.....8. **Ancylis.**
5. **M_3** and **Cu_1** united (fig. 264).....9. **Anchylopera.**
4. Fore wing not really falcate.
5. Hind wing with **M_2, M_3,** and **Cu_1** all remote at origin from cell (fig. 269).....33. **Polychrosis**
5. Hind wing with **M_2, M_3,** and **Cu_1** equally and very slightly separate; on superficial view, all connate; thorax smooth (fig. 268).
32. **Bactra.**
5. Hind wing with **M_3** and **Cu_1** connate; **M_2** slightly separate (fig. 262).
28. **Episimus.**
5. Hind wing with **M_3** and **Cu_1** connate, or stalked; **M_2** remote; male without costal fold.
6. Thorax with a posterior tuft.
7. Male hind tibiæ with metallic scales above, near base.
5. **Gymnandrosoma.**
7. Male hind tibiæ with normal loose hair.
8. Hind wing with a thickened area above base of **3d A** only (fig. 250).....6. **Ecdytolopha.**
8. Male with a fold on inner margin, normally containing a hair pencil, or a pencil arising from base of hind tibia, or, usually, both.....29. **Olethreutes.**
6. Thorax smooth.
8. Male hind tibia and tarsus with coarse, divergent hair.
4. **Melissopus.**
8. Male hind tibia with loose hair; tarsus scaled.
9. Male with base of hair pencil on **Cu** covered with large shining scales; a groove along **2dA,** containing the usual pencil arising from base of **2dA**.....3. **Carpocapsa.**
9. Male without sex scaling toward inner margin of hind wing.
2. **Laspeyresia.**

[27] In a few members of other genera the fore wing is more or less falcate, but the outer margin is hardly concave, or the apex is rounded over.

5. Hind wing with M_3 and Cu_1 connate, M_2 strongly curved and approximate to M_3+Cu_1 at base; thorax crested; inner margin of hind wing sexually modified; male without costal fold; hind tibia almost always with a hair pencil at base.
6. Inner margin of hind wing with a thickened free lobe. **31. Cymolomia.**
6. Inner margin of hind wing with a more or less distinct fold and hair pencil.
7. Hind metatarsus of male with a tuft above....**30. Phæcasiophora.**
7. Hind metatarsus of male smooth scaled.....**29. Olethreutes.**
5. Hind wing with M_3 and Cu_1 stalked or united; M_2 strongly curved and approximate to their base; thorax rarely crested; male often with costal fold, but rarely with other sexual modifications.
6. Fore wing with M_3 and M_2 connate; M_2 straighter than usual; no costal fold[28].....**20. Rhyacionia.**
6. Fore wing with M_2 separate at origin from M_3 and curved.
7. Male antenna with a notch near base.
8. Fore wing with a large raised scale-tuft in fold. **17. Strepsicrates.**
8. Fore wing smooth.
9. Costal fold present.....**Griselda** (p. —).
9. Costal fold absent.....**16. Spilonota.**
7. Male antenna without a notch.
8. Black sex-scaling toward costa of hind wing above. **21. Proteoteras.**
8. No black sex-scaling on costa of hind wing.
9. Male with costal fold.
10. Sc absent .....**14½. Hendecaneura.**
10. Sc present...**7. Epinotia, 13. Epiblema** and **14. Eucosma.**[29]
9. No costal fold.
10. Outer margin of fore wing evenly excurved; the veins evenly spaced.
11. Uncus slender, sometimes bifid at tip. **7. Epinotia,** in part.
11. Uncus rudimentary.....**25. Zeiraphera.**
10. Outer margin concave toward costa; M_3 somewhat upcurved toward margin; apex often with an ocellate black dot, making the apex appear more falcate than it is; R_2 normally arising from cell before commencement of accessory cell.
11. Hind wing with R and M_1 stalked.....**24. Gypsonoma.**
11. Hind wing with R and M_1 approximate.....**10. Norma.**
10. Outer margin more or less distinctly notched near middle; M_3 strongly curved up to margin.
11. Fore wing with more or less distinct raised scale-ridges .....**22. Gretchina.**
11. Fore wing smooth-scaled. **7. Epinotia, 15. Thiodia, 23. Exentera.**[30]

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[28] In occasional specimens M_2 and M_3 are perceptibly separate; they can generally be distinguished by the palpi, which have the vestiture of the second joint abruptly cut off at the end; the third joint well defined and projecting free (fig. 283).

[29] For a key to these species see Eucosma.

[30] These genera are distinguished only by the male genitalia. For a key to the species that may run here, see Thiodia.

10. Outer margin evenly incurved, but veins not approximate; apex marked; male with eighth segment modified.
11. Fore wing with R_2 arising from accessory cell, approximate of R_3; valves divided.....27. **Hystrichophora**
11. Fore wing with R_2 arising from before accessory cell halfway between R_1 and R_3; valve simple.
26. **Pseudogalleria**

Partial key to females of Eucosminæ

1. **R** and M_1 of hind wing widely separate (fig. 247).....1. **Hemimene**
1. **R** and M_1 approximate or stalked.
2. Fore wing falcate.
3. R_4 and R_5 long-stalked.....11. **Rhopobota**
3. R_4 and R_5 separate.
4. Hind wing with M_3 and Cu_1 stalked.....8. **Ancylis**
4. Hind wing with M_3 and Cu_1 united.....9. **Anchylopera**
2. Fore wing not falcate.
3. M_2, M_3, and Cu_1 of hind wing widely spaced at origin.....33. **Polychrosis**
3. M_2, M_3, and Cu_1 very shortly but equally spaced at origin, under low magnification appearing connate.....32. **Bactra**
3. M_2 separate; M_3 and Cu_1 connate.
4. Thorax tufted.
5. Fore wing with ground striate transversely; with speculum.
6. Fore wing more than twice as long as wide.....6. **Ecdytolopha**
6. Fore wing less than twice as long as wide.....5. **Gymnandrosoma**
5. Fore wing not striate transversely; without speculum; usually with "Exartema pattern" or transverse fasciæ.
29. **Olethreutes**, 30. **Phæcasiophora**, 31. **Cymolomia**
4. Thorax smooth-scaled.....28. **Episimus**
3. M_2 widely separated and nearly straight; M_3 and Cu_1 more or less distinctly stalked; wings with metallic bands.
2. **Laspeyresia** (fig. 248), 3. **Carpocapsa** (fig. 249), 4. **Melissopus** (fig. 252).
3. M_3 and Cu_1 stalked or united; M_2 separated but curved and approximate to them at base.
4. Fore wing with 11 veins; R_4 and R_5 united.
5. Hind wing with M_3 and Cu_1 united.....19. **Suleima**
5. Hind wing with M_3 and Cu_1 stalked.....18. **Sonia**, 12. **Kundrya**
4. Fore wing with R_4 and R_5 stalked.
5. Fore wing with raised scale-ridges or tufts.....22. **Gretchina**
5. Fore wing smooth-scaled.....23. **Exentera**
4. Fore wing with R_4 and R_5 separate or connate.
5. Fore wing with a large tuft in outer part of fold....17. **Strepsicrates**
5. Fore wing with small tufts.
6. Some green scaling.....21. **Proteoteras**
6. Gray.....22. **Gretchina**
5. Fore wing smooth; thorax sometimes tufted.
6. R_2 arising from discal cell; accessory cell short.
7. Fore wing with a contrasting marginal lunulate fascia.
26. **Pseudogalleria**
7. Fore wing with a dot at the slightly produced apex only.
8. Hind wing with **R** and M_1 stalked
14½. **Hendecaneura**, 24. **Gypsonoma**
8. Hind wing with **R** and M_1 approximate.....10. **Norma**

6. R_2 arising from the large accessory cell.
7. Apex and outer margin evenly rounded (figs. 253, 254).
8. M_2 of fore wing connate with M_3 and nearly straight.
20. **Rhyacionia.**
8. M_2 and M_3 of fore wing approximate and curved.
7. **Epinotia,** 14. **Eucosma,** 23. **Exentera,** 25. **Zeiraphera.**
7. Apex marked; outer margin evenly concave; the veins not converging toward margin.....27. **Hystrichophora.**
7. Apex rounded; the outer margin concave or notched at middle; and veins M_1 to M_3 approximating toward the concavity (figs. 255, 256).
7. **Epinotia,** 13. **Epiblema,** 14. **Eucosma,** 15. **Thiodia,** 23. **Exentera.**

Key to genera: larva (after Fracker)

1. Ninth segment of abdomen with seta i close to iii and usually on the same tubercle; not associated with ii.
2. Seta vi absent on ninth segment; tubercles black; crotchets uniordinal.
40. **Cnephasia.**
2. Seta vi present on ninth segment, usually associated with iv and v.
3. Adfrontal sclerites reaching vertex, and front reaching about two-thirds way.
4. Arms of epicranial suture concave above, meeting in an attenuate point.
5. Abdomen with setæ iv and v on first segment in a diagonal line, horizontal on seventh.
5. Abdomen with setæ iv and v on first segment nearly vertical, oblique on seventh.
6. Seta vi of ninth segment of abdomen on the same tubercle with iv and v .....16. **Spilonota** (fig. 286), 31. **Cymolomia.**
6. Seta vi normally on a separate tubercle.
3. **Carpocapsa** (fig. 285), 4. **Melissopus.**
4. Arms of epicrania straight above.
11. **Rhopobota,** 13. **Epiblema,** 21. **Proteoteras.**
3. Adfrontals extending two-thirds, and front one-half, way to vertex.
26. **Pseudogalleria.**
1. Ninth segment of abdomen with seta i as far from iii as from ii; iv–vi on one tubercle.
2. Wart vii of two setæ on seventh segment of abdomen and often one only on segment eight .....39. **Peronea** (fig. 244).
2. Wart vii with three setæ on seventh, and two on eighth, segment.
3. Middle seta of prespiracular wart dorsal of the other two.
34. **Sparganothis.**
3. Middle seta of prespiracular wart in line with, or lower than, the other two.
4. At least three times as far from posterior as from anterior seta.
5. Meso- and metathorax with vii single.
6. Second ocellus much farther from first than from third.
34. **Sparganothis** (group *Platynota*), 44. **Archips** in part (figs. 245, 246).
6. Second ocellus as near first as third.
9. **Anchylopera** (fig. 287), 28. **Episimus,** 29. **Olethreutes,** 34. **Sparganothis** in part, 43. **Tortrix.**

4. Middle seta of prespiracular wart not more than twice as far from posterior as from anterior.
5. Fourth ocellus much closer to third than to sixth, and behind the line joining third and sixth.....6. **Ecdytolopha.**
5. Fourth ocellus about halfway between third and sixth and in line with them .....2. **Laspeyresia** (fig. 284).

Key to genera: pupa (after Mosher)

1. With setæ on anal rise; without a distinct cremaster.
2. Two long distinct setæ on each side of anal rise.
3. One row of long strong flat setæ inserted along the row of spines at last segment.
4. Dorsum of abdominal segments covered, more or less, with short triangular spines; the spines of the anterior row alternately of two lengths .....13. **Epiblema.**
4. With the two regular rows of spines only, the anterior all of one length.
5. Exposed part of fore coxæ more than half the length of the mid-coxæ; body often stout.....3. **Carpocapsa.**
5. Exposed part of fore coxæ shorter; body always slender.
16. **Spilonota.**
3. A second row of setæ at caudal end of body, the first row consisting of four setæ.
4. Second row also of four setæ; maxillary palpi touching maxillæ.
5. Second row with middle setæ much slenderer than lateral ones; maxillæ less than a third the length of the wings; labial palpi about two-thirds the length of the maxillæ; maxillary palpi touching front legs .....1. **Hemimene.**
5. Setæ of caudal row all similar; maxillæ at least one-half the length of the wings; palpi about one-half the length of the maxillæ, maxillary palpi touched by middle leg also.....9. **Anchylopera.**
4. Second row of two setæ; maxillary palpi reaching maxillæ.
7. **Epinotia,** 24. **Gypsonoma.**
2. Never with two long distinct setæ at each side of anal rise.
3. Lateral spines of last segment noticeably enlarged; setæ at caudal end very weak and obscure; usually with two pairs of obscure setæ on anal rise.....7. **Epinotia** (Catastega).
3. Lateral spines of last segment not noticeably larger than the others; setæ at caudal end long and heavily chitinized, on a distinct papilla on each side of anal rise.....2. **Laspeyresia.**
1. With a well-developed cremaster.
2. Ninth segment of abdomen with a distinct row of spines, strongest in male; last segment sometimes with spines; cremaster broader than long; always with setæ on anal rise.
3. Cremaster not curved ventrad; the corners not produced into prominent hooks, but usually ending in three short lobes; second segment of abdomen with anterior row of spines present, and posterior row strong; setæ on anal rise lateral to anal opening.
4. Last segment with spines, usually three or four crowded rows.
5. With strong setæ on anal rise.
6. Two setæ on each side, much like those of cremaster..28. **Episimus.**
6. One seta on each side, smaller than those on cremaster.
29. **Olethreutes** in part.

5. No setæ on anal rise; spiracles at the bottom of deep pits. **33. Polychrosis.**

4. Last segment without spines.
5. Well-developed setæ on each side of anal rise.
6. Maxillary palpi reaching maxillæ.....29. **Olethreutes** in part.
6. Maxillary palpi short, not reaching maxillæ..31. **Cymolomia** in part.
5. No setæ on anal rise.....31. **Cymolomia** in part.

3. Cremaster curved ventral, the posterior angles ending in prominent hooks; second segment of abdomen with anterior row of spines absent, and posterior weak; setæ of caudal rise attached farther back.
4. Maxillary palpi present; anterior spines of segments seven to nine on distinct ridges which show on lateral margin of body, the spines on some segments extending below spiracles.....38. **Argyrotoxa.**
4. Maxillary palpi absent externally; anterior spines of segment nine not on distinct ridges, the spines not extending as low as spiracles; setæ on ventral side of cremaster short and heavily chitinized..39. **Peronea.**

2. Ninth segment of abdomen with a few scattered spines, in male; no setæ on anal rise; cremaster nearly always longer than broad; last segment never with spines.
3. Segmental membranes showing prominent dark brown spines scattered over a light brown surface.
4. Cremaster much longer than broad, not flattened.
5. With four setæ at end of cremaster.
6. Anterior spines of segment two of abdomen weak in male and absent in female; head without an anterior projection. **41. Harmologa.**
6. Anterior spines of segment two of abdomen well developed; head often with an anterior projection.....44. **Archips** in part.
5. Two setæ at end of cremaster....34. **Sparganothis** (group *Cenopis*).
4. Cremaster broader than long, flattened.....30. **Phæcasiophora.**

3. Conjunctiva smooth and evenly colored.
4. Cremaster longer than broad, not flattened; palpi considerably more than half as long as maxillæ.....34. **Sparganothis.**
5. Cremastral setæ flattened; anterior spines of second segment of abdomen wanting in female.....group **Platynota.**
5. Cremastral setæ not flattened; anterior spines of segment two present in female.....group **Epagoge.**
4. Cremaster broader than long, distinctly flattened; palpi not more than half as long as maxillæ.....44. **Archips** in part.

Subfamily **EUCOSMINÆ**

(*Grapholithinæ, Epibleminæ, Olethreutinæ*)

This subfamily appears to represent a fairly marked group, though defined by no single character at any stage. The genera are in part ill-defined, or distinguished mainly by genitalic characters revealed only by dissection. Heinrich's recent study (United States National Museum, Bulletin 123) has been followed, but externally visible characters have been used as far as possible. In some cases it has been necessary to treat two genera as a unit for the sake of the specific key.

Valves strongly chitinized; with narrow basal articulation, articulating with the juxta; inner face of valve chitinized except at base; anellus consisting of a triangular plate with an external central arm supporting the ædœagus. Larva with setæ i and iii of ninth segment of abdomen normally on a single plate.

1. *HEMIMENE* Hübner

(*Dichrorampha* Guenée; with *Lipoptycha,* in part)

Antennæ simple; palpi moderate (fig. 271), porrect, long-hairy, with the third joint almost as long as the second but mostly concealed in its hair; head nearly smooth; eyes small, with a naked area behind them (fig. 271). Thorax smooth. Fore wing rather broad for a Eucosmid (fig. 247); the outer margin not noticeably oblique; more or less concave above the middle; tending to form a slight notch at M_1; veins all present and distinctly separate; the base of M_3 and R_{4+5} usually distinct. Cu running through middle of wing or rather above; R_3 arising at least 2½ times as far from R_2 as from R_4. Hind wing proportionate; with R and M_1 well separated, more than a third as far as M_1 from M_2, and more than half as far as M_2 from M_3, which are separated more than half as far from each other as M_1 from M_2; M_3 and Cu_1 connate or short-stalked.

This is the genus as defined by Busck. Meyrick and others have excluded the species without the costal fold, referring them to Lipoptycha. The larvæ are usually borers in stems and roots of Compositæ. This genus and Laspeyresia dispute the position of lowest of our North American Tortricidæ.

Key to the species

1. Fore wings with cream-white dorsal spot.....6. *incanana.*
1. Fore wings with a yellow dorsal spot.....5. *simulana.*
1. Fore wings with a vague yellow dorsal shade, or none; rarely, with short, well-separated, yellow striæ.
2. Apex purplish, contrasting with the tawny base.....1. *plummeriana.*
2. Apex not purplish and contrasting.
3. Fore wing with undulating black transverse lines.....2. *leopardana.*
3. Fore wing without such lines.
4. Light golden yellow.....4. *bittana.*
4. Dark fuscous, without yellow.....3. *dana.*

* *No costal fold* (Lipoptycha *auct.*).

1. **H. plummeriana** Busck. Palpi clay-color, with a good many black hairs mixed with some pale ones. Fore wing with base to middle of costa and three-fourths way out on inner margin dull clay-color, strigose, dusted with black; the outer half contrasting yellow-brown, with confused fasciæ and marbling of lead-gray, and some black scales, which tend to gather as a lead-and-black fascia along the inner margin of the dark part. Some partly confluent black terminal dots, followed by a fine yellow line, below the notch, and a single black dot above it; with clay-colored costal striæ on outer part of wing. Terminal dots and costal striæ repeated on under side. Hind wing light gray. 10 mm.

April to June. Larva in flowers of pawpaw.

District of Columbia; Cincinnati, Ohio; Urbana, Illinois.

2. **H. leopardana** Busck. Bright orange-ochre, contrastingly marked with a mixture of lead-gray and brown-black streaks and partly confluent spots, tending to became oblique streaks along the costa. Terminal dots distinct and separate; below the notch. Fringe gray, cut with yellow at notch; hind wing dark. 8 mm.

May to August. Larva on Eupatorium.

Maryland to Cincinnati, Ohio.

3. **H. dana** Kearfott. Fuscous, with the usual yellow patch on side of palpi, but no other yellow. Fore wing with slight leaden lustre, tending to become

brighter on outer half; outwardly with many of the scales luteous-tipped, giving a frosted appearance; leaving several lead-gray bands of the ground, which are strongly oblique toward costa, parallel to outer margin below, and confused in the middle; with a few black spots and streaks in the yellow-dusted portion; with a series, usually of four strong terminal dots, below the notch, and sometimes one small one above it. Hind wing solid dark. 12 mm. (*Enarmonia* Kearfott.)

This species has been determined as *Laspeyresia nigricana*, but may be distinguished by the generic characters and by the terminal spots. Very close to *H. plumbana* Scopoli of Europe, and *H. sedatana* Busck, of Colorado, of which it is likely to prove the eastern race.

Late May and June.

New Hampshire to western Pennsylvania; common and generally distributed. New York: Black Brook, Batavia, Rock City (Cattaraugus County), Crosby, Ithaca, McLean.

** *With costal fold* (Hemimene).

4. **H. bittana** Busck. Fold large, extending a third of the length of the fore wing. Fore wing golden or orange-ochre, more or less suffused with brown; the base almost always paler or darker brown; the outer half, especially toward inner margin, very rarely wholly brown except for a portion of the postmedial region. The markings tend to be black striations on the veins in the middle of the wing and curved transverse striæ at the middle of the inner margin; base almost evenly colored; a lead-colored postmedial band well out toward margin, sharply bent opposite notch and parallel to margin below, with a short lead-gray bar beyond it on costa; normally with fine broken black striæ between them. Black terminal dots conspicuous, at least below notch. 12–15 mm. (*alpinana* Fernald in part, not Treitschke).

June and July.

Rather common and general in distribution. New York: Ithaca.

5. **H. simulana** Clemens. Second joint of palpus with yellow body and brown hair. Fore wing gray-brown, with a large, half-crescent-shaped, bright yellow patch on middle of dorsal margin; outer half with grayer shining bands, separated by areas of yellow-tipped scales, and a few subterminal black dots as well as the terminal ones. 10 mm. (*alpinana* auct., not Treitschke).

End of May; end of August.

Parry Sound, Ontario, to southern New Jersey, Pennsylvania, and District of Columbia. New York: Ithaca, West Farms.

6. **H. incanana** Clemens. Blackish, varied with dull white; with an oblique white dorsal patch, formed of two pairs of fused striæ ending on the ochreous speculum, which has three black bars and lies at the middle of the subterminal region.

I have seen only the type. (*Halonota* Clemens).

Pennsylvania?

1½. *PAMMENE* Hübner

Similar to Laspeyresia. Male with R of hind wing arising widely separate from M_1, running directly across into Sc, as in some Pyralids. Female as in Laspeyresia.

1. **P. felicitana** Heinrich (Kearfott, ms.). Purple-black, varied in median area with shining purple-gray, and sometimes with some whitish scaling toward base; the two outer lead-colored fasciæ showing a distinct purple shade, and the speculum narrow, with a few black spots rather than bars. Outer part of wing sometimes shaded with brown; sometimes with a brown terminal line; and usually with the ground in the speculum lighter, sometimes luteous. Inner margin to beginning of speculum broadly and irregularly cream-white, sometimes with a

couple of spots of the ground color; the white area extending nearly to the costa at base. Hind wing mouse-gray. 13 mm.

June; August and September.

Western Pennsylvania; Montreal and St. Hilaire, Quebec.

2. *LASPEYRESIA* Hübner

(*Grapholitha* Rebel, etc.; *Enarmonia* Fernald, etc.; *Ephippiphora*, of the earlier writers)

Palpus with second joint merely rough scaled below (fig. 272), the vestiture not concealing the third joint, which is usually about a third as long as the second, and scaled. Thorax and fore wing like Hemimene; hind wing with **R** and $\mathbf{M}_1$ more approximate at base (fig. 248), usually somewhat sinuous, and diverging abruptly about a third way to margin. $\mathbf{M}_2$ strongly curved but well separated from $\mathbf{M}_3$ which is connate or stalked with $\mathbf{Cu}_1$. No sexual modifications, except for some dense scaling on the hind wing of *L. pyricolana*.

The species are numerous and close and the following key may not be always successful.

Enarmonia dana Kearfott is a Hemimene; *L. lautana* is strongly aberrant, and represents a new subgenus **Sereda** Heinrich; *L. shawiana* is a Hendecaneura. Aside from the slight difference in venation and palpi, the genus may be distinguished from Hemimene by the absence of terminal dots just back of the outer margin, below the notch; usually there are no terminal dots at all, but in *L. lautana* they are present exactly on the margin of the wing membrane, and are strongest on the apical part of the wing.

Key to the species

1. Two terminal dots at apex noticeably larger than the others.....1. *lautana.*
1. A single larger terminal dot at apex, or none.
2. Hind wing half or more pure white.
3. Fore wing blackish.
4. Fore wing with a white crescent at middle of inner margin. 21. *albimaculana.*
4. Fore wing with only a faint gray crescent at middle of inner margin. 10. *eclipsana.*
3. Fore wing gray.....18. *multilineana.*
2. Hind wing fuscous to blackish; sometimes with more or less of base dirty white.
3. Ground of fore wing dull white.
4. Outer half contrasting dark, largely blue.....20. *fletcherana.*
4. Base of inner margin and outer third spotted with blackish. 22. *gallæsaliciana.*
3. Ground of fore wing blackish.
4. Two strongly irregular silver-white striæ clear across the wing..16. *rana.*
4. A contrasting white crescent or group of striæ on middle of inner margin, reaching up about to middle of wing, but entirely separate from the costal striæ.
5. Dorsal white extended in along inner margin to base. (*Pammene felicitana.*)
5. Dorsal spot a group of four or more fine, more or less fused striæ, costa strongly striate with white.....15. *tristrigana.*

5. Dorsal spot composed of two or three more or less fused striæ; or single and reaching well above fold, but not extended toward base; if of three striæ, costa not striate with white.
6. Speculum represented by a single lead-gray band; ground wholly black-brown ..... 6. *interstinctana.*
6. Speculum yellow-brown, regularly barred with black, the ground otherwise black-brown ..... 9. *fana.*

4. No contrasting white mark at middle of inner margin.
5. Even blackish with white spotting; tending to form broken transverse bands ..... *albolineana.*
5. Not evenly blackish without speculum.
6. Light gray ..... 19. *garacana.*
6. Blackish.
7. Speculum absent; represented by a single lead-gray bar. 8. *saundersana.*
7. Speculum present; normally of two lead-gray bars, with a yellower area between them containing black markings.
8. With contrasting white costal striæ from a quarter way out on costa to apex ..... 7. *angleseana.*
8. No white costal striæ before middle of wing.
9. Ground mottled with yellow-ochre ..... 3. *prunivora.*
9. Ground brown, with scattered, luteous-tipped scales, at least on outer part of wing; denser outwardly; the speculum often nearly solid luteous.
10. Speculum higher; its uppermost bar above or hardly below the notch on the outer margin; hind wing pale on basal half ..... 2. *caryana.*
10. Speculum of four black bars, distinctly farther from costa than the notch; hind wing solid blackish, except on covered part of costa.
11. With well-marked costal white striæ ..... 14. *candana.*
11. No distinct white costal striæ ..... 13. *dandana.*
9. Fore wing with white-tipped scales ..... 17. *molesta.*
9. Ground solid black-brown, or nearly so.
10. Two median lead-gray fasciæ, nearly in contact, and so broad as together to be more than a third as wide as the breadth of the wing ..... 11. *youngana.*
10. Median fasciæ narrower and obscure or absent.
11. Hind wing very pale gray at base and beneath; black dots in speculum nearly obsolete ..... 5. *packardii.*
11. Hind wing not paler at base; black dots distinct.
12. First line of speculum parallel to outer margin; fringe of hind wing gray ..... 23. *pyricolana.*
12. First metallic line of speculum erect; fringe of hind wing white except at base ..... 12. *nigricana.*

Omitted from key: 4. *nigromaculana.*

* *Outer margin strongly oblique, hardly notched at* M_1; R_5 *running to apex or very slightly below; hind wing with fringe on* Cu *very weak and almost always lost; head rough, with strong hair on palpi; eyes smallish, but round* (Sereda *Heinrich*).

1. **L. lautana** Clemens. Powdery light gray, the outer half noticeably strigose with white, which tends to gather in a patch at middle of inner margin. Antemedial line strongly bent on cell, and oblique above; the base up to it more solidly

dark; outer and costal parts of wing with lead-colored stripes, the next to last usually running to anal angle; all starting from paired white costal striæ. Five or six terminal dots on upper part of wing, the two at apex decidedly larger and a little separated from the others. 12 mm.

April and May.

This species is side-specialized in the direction of the Tortricinæ and Eucosma.

New York and Pennsylvania to Manitoba. New York: McLean, Ithaca, Ramapo.

** *Outer margin of fore wing nearly upright, with well-marked notch;* R_5 *terminating well below apex; hind wing with strong fringe on* Cu; *head and palpi generally smoother, the eyes normally large* (Laspeyresia).

† *Male without sexual modifications.*

2. **L. caryana** Fitch. Palpi whitish. Deep brown, with lead-colored stripes, not strongly contrasting, and distinct only on costa, except the last two, which enclose the speculum. Ground dusted in two or three areas with cream color; the dusting in the speculum dense; speculum with four or five black bars of unequal size, the first strong one pointing directly to the notch in the outer margin. White costal striæ distinct outwardly, but not prominent. Hind wing fuscous, whitish on basal half; fringe whitish, with fuscous basal line. 10–12 mm.

May, July and August. Larva on hickory and walnut; the second brood eating out the young nuts; also inquiline in galls.

Canada to Missouri and Georgia. New York: Easton (type).

3. **L. prunivora** Walsingham (lesser codling-worm). Face and palpi whitish. Black-brown varied with ochre yellow; the outer margin below costa almost solid yellow in some specimens, except for some black bars and the two lead-colored bands; middle of wing more or less striate with black; middle of inner margin with confused oblique streaks. Costal edge outwardly with some white dots. Speculum of the yellow, with black bars, decidedly lower than the notch, as usual in the genus. Hind wing like *L. caryana*. 9 mm.

In dark specimens the yellow is reduced to some few scales on the disc of the fore wing, in the upper part of the speculum, and just before the apex.

Larva in young plums, Cratægus fruit, and crab apples.

Generally distributed. New York: Crosby (Yates County), Ithaca.

4. **L. nigromaculana** Kearfott. Palpi more than half luteous, with dark tips. Fore wing cream color on basal half, the ground more than half covered with wavy brown transverse bands, which leave a vague pale area in the middle of the inner margin; outer half mixed bright ochre and black-brown, not contrasting to the naked eye; with some black dots and striæ, and with strong black terminal spots. 9 mm.

June.

Black Mountains, North Carolina.

Superficially very close to *Laspeyresia prunivora*, with which Kearfott has confused it. Types only seen.

5. **L. packardii** Zeller. Dull blackish; head and palpi gray (unlike *L. caryana* and *prunivora*); fore wing with lead-gray fasciæ leaving a distinctly defined but not contrasting brownish erect median fascia, and a similar subtriangular patch at anal angle. Speculum with a couple of faint dots only. Hind wing very pale gray, with dark border and veins.

This species can apparently be distinguished by the partly pale hind wings and gray palpi. I have no notes on authentic material. *L. pyricolana* has been determined as this, in error.

Texas; doubtful northward.

6. **L. interstinctana** Clemens. Deep brown, about eight white costal striæ, on ıe outer three-fourths of costa; two larger curved striæ at middle of inner argin, reaching about up to cell; a lead-colored bar before anal angle. Hind ing solid black-brown. 9 mm.

Common in May and June; and again in late July and August. Larva (the over seed caterpillar) in flower heads of clover, damaging the seed.

Generally distributed. New York: Newport, Ithaca, Big Indian Valley, New ork City.

7. **L. angleseana** Kearfott. Basal half chocolate brown; outer half brown with rong golden iridescence. Costa with nine white striæ, the first two, fourth, eventh, and ninth forming the end of short lead-colored bars; the third weaker. hree lead-gray bars on inner half of wing, the area between the first two strigose ith black; the speculum lying between the outer two, barred with black. Outer ıargin blackish. Hind wing solid dark. 10 mm.

End of May to June; August. Locally common.

Anglesea, New Jersey; Massachusetts.

8. **L. saundersana** Kearfott. Black-brown. Costa with about 10 white striæ, ıore oblique than in *L. angleseana;* several of them ending in lead-colored bars. ı vague pale crescent beyond middle of inner margin, extending half way to osta, formed of four pale striæ which end above in a lead-colored spot. A single ead-gray bar in position of speculum. 10 mm.

Toronto, Ontario. New York: Karner (Forbes).

9. **L. fana** Kearfott. Black-brown; costal marks about like *L. angleseana.* Mid- le of inner margin with a white spot, formed of two thick and partly fused hite striæ. Speculum chocolate brown with four black bars, the lead-gray bar eyond it much shorter than the one before, being cut off below by the edge of the ing. 7½–10 mm.

May to August. Larva amber colored; a bud-worm on Meibomia (Kearfott).

New Jersey to Ohio.

10. **L. eclipsana** Zeller. Deep brown; costal striæ as in *L. angleseana,* but all listinct, strongly oblique, the lead-gray stripes silvery and conspicuous, and the triæ which do not end in lead-gray streaks, running into shorter luteous ones. Speculum with the lead-colored bars rather close together, the black showing as spots rather than bars; or, speculum filled largely with black; with faint traces of a pale half-crescent on middle of inner margin, ending in a lead-colored spot at middle of wing. Hind wing white; the apical third blackish. 12 mm.

April to May. Larva on grape.

New Jersey and Ohio to Texas. New York: Ithaca.

11. **L. youngana** Kearfott. Fuscous, broadly banded with lead-color except oward base. The two median bands complete but irregular, and very broad, the outer ones narrower and more or less broken; all starting from slight pale costal spots. Speculum hardly paler, with four black bars, and with a lead-gray spot below it, as well as the bars before and beyond; a distinct narrow yellow terminal line before the black line in the fringe, but no other yellow. Line in fringe eavily cut with white at notch. 8–11 mm. (*perstructana* Walker?).

Larva in center of cones of *Picea alba,* hibernating as a larva and emerging in he spring.

Ottawa, Ontario.

12. **L. nigricana** Stephens. Black-brown, with some pale striation on outer part of costa; the two lead-colored stripes narrow and broken, the upright part outlining the speculum perpendicular to the inner margin, and separate from the costal part, which runs obliquely across the apex. Speculum with black bars, the series quite obscurely continued to costa, forming an oblique series between the two lead-colored stripes. Hind wing blackish brown, hardly paler at base, the fringe contrasting, white, with a gray line in the base. 12 mm. (*novimundi* Heinrich).

Almost identical in appearance with *Hemimene dana*, but differing in the palpi, the venation, and the submarginal, instead of marginal, position of the series of black dots.

June to August. Larva in pods and seeds of peas and other Leguminosæ; sometimes injurious.

New Jersey and western Pennsylvania to Manitoba; also reported as injurious in Nova Scotia.

13. **L. dandana** Kearfott. Dull dark brown, with some slight pale scaling on costa, and scales outwardly showing pale tips in some lights. Two oblique bluish iridescent stripes running down and out from costa toward apex, with a fine black line half way between them; two purpler and duller bands before anal angle enclosing about four black spots, to form speculum. Hind wing concolorous. 10 mm.

End of August to September.

Essex County, New Jersey.

14. **L. candana** Kearfott. Much like *L. dandana* but larger; the metallic bands narrower and more broken; the black line between them obscure or lost; pale scaling more distinct, but more nearly confined to speculum. Hind wing with contrasting white fringe; without dark basal line. Possibly the spring brood of *L. dandana*.

May.

Western Pennsylvania; Virginia.

15. **L. tristrigana** Clemens. Dark brown, sometimes varied with black; speculum represented by a lead-colored bar only; about 10 or 12 closely crowded but clean-cut white costal striæ, leaving only base of costa free; a group of four to six partially fused striæ on middle of inner margin, each one curved out in a quarter circle; their tips followed by some luteous scaling. Hind wing concolorous; outer part of fringe contrasting whitish. 12–15 mm.

Larva on "Tinctoria" (perhaps *Baptisia tinctoria*).

Massachusetts to Florida, Kansas, and Oregon.

16. **L. rana** Kearfott. Deep brown; a strong double medial, strongly waved but not distinctly broken, silvery band; and a single postmedial band, each of these starting from a pair of white costal dots. Another single white subterminal dot on costa, and a pair before apex. Speculum preceded by the postmedial band, followed by a vertical dark-silver bar, and crossed by four black bars; the ground concolorous. Hind wing dark. 14 mm.

May.

Black Mountains, North Carolina.

17. **L. molesta** Busck. Dark fuscous, with some white-tipped scales; head dark, including palpi. Fore wing with traces of the dorsal crescents showing as a gathering of the white-tipped scales. Speculum strongly white-dusted, with from three to six blackish dots. Hind wings blackish, with fringe whitish except at apex. 10–15 mm.

Two or three broods, breeding more or less continuously. Larva injurious to stone-fruits, especially peach; boring out or gnawing the surface of growing twigs, and boring in the fruit. Cocoon in any sort of shelter, that of the last brood often under bark.

Vicinity of Washington, District of Columbia; probably introduced from Japan.

18. **L. multilineana** Kearfott, with the fore wing powdery gray, and the hind wing white, has been taken at Jamestown, New York, in June.

19. **L. garacana** Kearfott. Light gray; the ground being made up of luteous mottling and dusting on a dark gray base, leaving the dark as a series of parallel but unequal and broken streaks. Base slightly darker; a distinct narrow dark median fascia running from middle of costa to before middle of inner margin, bent at a right angle on cell, the lower part more oblique than the outer margin. A

similar straight subterminal bar on inner half of wings only. Speculum obscure, high in the wing; black line in base of fringe clean-cut, and cut with white at the notch. 15 mm.

July. Types only seen, male and female.

Trenton, Ontario; Chicago, Illinois.

20. **L. fletcherana** Kearfott. Basal half of wing and body dirty white; outer half a mixture of blackish and steel-blue, with some wood-brown and a little whitish scaling; the terminal line normally brown. Line in base of fringe continuous, black, interrupted at notch with white. Hind wing fuscous, paler at base. 13 mm.

June.

Ottawa, Canada. A paler variety occurs in Washington.

21. **L. albimaculana** Fernald. Fuscous gray; costal edge black, irregularly barred with white, the white bars fading into the grayish ground below. Inner margin heavily shaded with black, especially beyond the white dorsal patch, which is moderate in size, rarely divided into two striæ, and extends obliquely out and up to middle of wing. Outer part of wing with some yellowish tint; the lead-colored stripes broken and irregular, with irregular black spots between them representing the speculum. 8–12 mm. (*articulatana* Kearfott).

April 30.

Maine to Manitoba.

22. **L. gallæsaliciana** Riley. White. Head and thorax white; abdomen dark gray. Fore wing irregularly spotted with gray, shading into yellow brown or golden at the apex; the gray gathering to form a patch on outer margin, a third the length of the wing on the inner margin, but often hardly reaching the costa; and an antemedial patch toward inner margin. Speculum with heavy lead-colored bands, with some heavy black dots before and within it. Hind wing light gray, paler, and striate with dark gray beneath. 12 mm.

June and July. Larva in a slender twig-gall on willow, perhaps inquiline.

This species has been generally confused with a western Epinotia which has a costal fold in the male. The hind wing has **R** and $\mathbf{M}_1$, and $\mathbf{M}_3$ and $\mathbf{Cu}_1$ short-stalked and $\mathbf{M}_2$ more curved than usual in Laspeyresia.

Mt. Washington, New Hampshire, to Missouri. New York: Peru, Big Indian Valley.

†† *Male with a patch of rough scaling on upper side of hind wing and one on under side of fore wing.*

23. **L. pyricolana** Murtfeldt. Dark fuscous; head and palpi dark; fore wing with several transverse lead-gray fasciæ, the median ones nearly complete. Speculum with two lead-gray bars, parallel to outer margin, and also connected with oblique fasciæ running down from the costa. A distinct series of black dots or short bars in the speculum, and between the speculum and the costa, extending most of the width of the wing. Basal line in fringe unbroken. Hind wing in male light gray, no darker at the margin, with a blackish sex-patch covering most of cell and extending a little beyond it; in female blackish. Fringe gray. 10 mm. Male usually smaller. (*Penthina cyanana* Murtfeldt in part, by type lot; *packardi* of collections; *Steganoptycha, Epinotia.*)

May and June; August; ————. Three broods. Larva green, (?) the spring brood boring into the buds of rose and blasting them; the later broods normally feeding on the leaves. Pupa under the edge of a leaf folded over, or boring into pith. Also with similar habits on apple and peach. The larva is a little doubtful on account of confusion with *O. cyanana*, but the dates and food plants are certain.

3. *CARPOCAPSA* Treitschke

(*Cydia; Laspeyresia,* in part)

Antennæ smooth; palpi almost smoothly scaled (fig. 273), obliquely upturned, with short third segment, as in the smoothest species of Laspeyresia. Thorax smooth. Venation as in Laspeyresia, the notch at **M** hardly visible. Hind wing of male (fig. 249) with the fringe on **Cu** very strong, dark, and deflected downward by a mass of shining scales in the lower part of the cell, which turn down across the base of the fringe. A broad groove along **2d A,** containing the pencil arising from the basal fork of the vein; anal region with slightly modified general scaling. Larva without anal fork.

The genus is of moderate size; the larva feeding in fruits and seeds. It is well represented in the West and in Europe, but has only a single introduced species in the Northeast, the famous codling worm. The sexual characters are different in almost every species and the genus is hardly distinct from Laspeyresia.

I have placed *C. toreuta* and *erotella* here temporarily, following Heinrich. They are not true Carpocapsas, but so far as I know they have no valid generic name. The whole group they represent are feeders on conifers. *Laspeyresia youngana,* also, should probably be grouped with them.

1. **C. pomonella** Linnæus (the codling-worm). Gray, with fine striation, showing under a lens as white tips to blackish scales; base, or a broad antemedial band, slightly darker, with excurved and scalloped outer boundary; speculum of two bronze-brown bars, the outer one more or less broken up, filled in with chocolate brown, the brown extending to form a large oval area almost reaching costa and outer margin; costa and extreme outer margin striate and gray like the base. No black in speculum, but speculum preceded by a heavy vertical black bar, ending in a point halfway to costa. Fringe with a black line, and sometimes cut with white at M_1. Hind wing brown; the enlarged scales covering **Cu** in the male lead-color; the hairs of the fringe on **Cu** blackish. 15–20 mm.

The codling moth is generally distributed and injurious wherever apples are grown; occasionally it feeds in the fruits of a few other Rosaceæ, especially pears. Northward there is but a single brood, the moths emerging in the spring (soon after the blossoms fall) and laying their eggs on the outside of the young apples. The larvæ enter by the calyx-cup and feed on the inside of the fruit, including the growing seeds, growing slowly. They leave the fruit late in summer and form their cocoons under the bark or, more rarely, in trash on the ground, hibernating as larvæ and pupating in the early spring. Southward there is a second brood, the moths emerging in July and August, and laying their eggs on the well-grown apples. The larvæ of this brood often enter the side of the apple and feed less systematically, leaving the apple late in the fall and hibernating like the single-brooded forms. They are sometimes known as "side-worms."

2. **C. toreuta** Grote. Dark gray; basal fourth, medial, and postmedial fasciæ lead-gray; also two subapical dots and a marginal line half as wide as the fasciæ.

Larva in cones of yellow pine.

Falls Church, Virginia; North Carolina; and west. The moth is perhaps widespread in the East, but is rarely obtained save by breeding.

3. **C. erotella** Heinrich. Lead-color. Two shining fasciæ before and beyond middle of wing, each starting from a double pale stria at costa, excurved, and farther out on inner margin; a short bar on costa at three-fourths, also starting from a double stria; and an irregular and broken subterminal line, preceded by one or two black spots below middle of wing. Fringe with black basal line, cut with whitish below apex; outer part of fringe shining lead-gray. Hind wing concolorous. 9–10 mm.

March (perhaps forced); August. Larva in pitch nodule or gall on *Pinus tæda,* the type bred in association with *Rhyacionia comstockiana.*

Maryland; Mississippi.

4. *MELISSOPUS* Riley

Metallic scaling more extensive than in *Carpocapsa pomonella*. Hind tibia of male with very long hair below and above toward its tip, and metatarsus with heavy hair above; hind wing (fig. 252) roughly and thickly scaled on inner margin and at base of **Cu** and **2d A**, but without hair pencils. Otherwise like Carpocapsa and Laspeyresia.

1. **M. latiferreanus** Walsingham. Light red-brown, with a heavy erect median lead-colored fascia; a slightly narrower one three-fourths way out; and a slender and broken submarginal one, strongly curved below costa. Between the two outer fasciæ there are some broken black bars and streaks. Fringe lead-colored, with a reddish line in the base; hind wing mouse gray. **15 mm.**

Two broods in Missouri, the second perhaps partial; July and August; late September. Larva on young acorns; cocoon formed between a leaf and a nearly circular piece cut out of another.

Our eastern form, as described above, is var. **orichalceana** Walsingham. Typically the second fascia is rudimentary (California).

Generally distributed north to Montreal. New York: Ithaca, Karner.

5. *GYMNANDROSOMA* Dyar

Similar to Ecdytolopha; palpi with third segment porrect, slightly more beak-like. Wings (fig. 251) more than half as wide as long, and rough-scaled; thorax tufted behind. M_2 of hind wing more curved than in Ecdytolopha. Abdomen of male with a naked patch above, flanked by a couple of pale hair-pencils; hind tibia with a fanlike tuft of hair, with metallic scales at its base. Hind wing with heavy tufts of hair and enlarged spatulate scales on inner margin; the fringe on **Cu** extremely heavy, but not modified.

1. **G. punctidiscanum** Dyar. Irregularly mottled and strigose with fuscous, blackish, and some lead gray, the outer part often largely dirty white and contrasting. Discal dot small, white, sharply defined in a black shade. No definite line in fringe. Hind wing mouse gray. 18–25 mm.

The moth has been taken from May to July.

New Jersey and northern Illinois to South Carolina. New York: Ithaca, New York City; Maspeth, Long Island.

6. *ECDYTOLOPHA* Zeller

Palpi rough-scaled; upturned to middle of front; with short third joint (fig. 277). Thorax tufted behind; wing rough with transverse ridges of slightly enlarged raised scales, two and one-half times as long as wide; with rounded outer margin and no distinct notch; all veins separate and normal. Hind wing (fig. 250) with **R** and M_1 approximate, M_2 widely separate, and parallel to M_3, nearly straight; M_3 and Cu_1 connate; the male with a thickened patch above **3d A** at base, but not otherwise modified. Tibiæ with the usual hair only.

This genus seems intermediate between Laspeyresia and Olethreutes, and together with Gymnandrosoma, has been sunk to the latter by Walsingham and Durrant.

1. **E. insiticiana** Zeller. Basal half fuscous, mottled with dull black; outer half dirty white, striate and mottled with fuscous and some black; the boundary somewhat oblique and nearer base on inner margin; sharply defined below, diffuse above; the outer markings usually forming a small triangular largely black anal spot. Hind wing mouse-gray. 25 mm. (**H 48**:29.)

May to August. The larva may be found in August, in twigs of locust, making a fusiform gall which is sometimes very slightly swollen when in stout twigs. The passage to the exterior is kept open and the frass thrown outside. The larva

leaves the gall to pupate, and forms a cocoon between two fallen leaves. It cuts a kidney-shaped piece nearly out of each leaf and sews them together at the edges, but leaves the cocoon suspended by a few uncut veins.

Generally distributed from Northern Vermont southward; replaced by a closely related species in Mexico. New York: Peru, Lewiston, Baldwinsville, Rochester Junction, Ithaca, Karner, Rhinebeck, and New Windsor.

2. **E. islandana** Kearfott. Pale dull brown, evenly and coarsely strigose with fuscous gray and blackish; the inner edge black toward the base, and usually with the somewhat darker base ending in a distinct black stria at the middle of the inner margin. Hind wing gray, paler at base. 15 mm. (*Olethreutes* Kearfott.)

May. Types only seen; in poor condition.

Plummer's Island. Maryland.

The generic position of this form is not yet certain, as it lacks the secondary sexual characters of Ecdytolopha. It is certainly no Olethreutes.

7. *EPINOTIA* Hübner

(With *Zeiraphera; Enarmonia; Steganoptycha; Thiodia; Eucosma,* in part)

Fore wing with outer margin evenly excurved; more or less concave or notched, apex blunt; costal fold sometimes present. All veins present, M_1 to Cu_1 convergent at margin in forms with a notch; R_1 from before middle of cell; R_2 slightly nearer R_3 than R_1, arising from accessory cell. R_5 rarely short-stalked (fig. 254).

Valve simple; cucullus and anal indentation variable; the latter not densely spined, and usually narrow; sacculus with spines. Uncus strong and simple, or bifid, or reduced and simple; socii large, chitinized when slender; typically triangular and hairy.

This genus would appear to contain the most primitive of this series of Eucosminæ. It is heterogeneous, but all the characters seem to intergrade. The species are not keyed separately, but are included in the keys to the genera Thiodia, Charlotta, and Eucosma, which they resemble in venation.

I. *Outer margin evenly rounded out; the veins almost evenly spaced at outer margin; cell* Cu_1 *less than twice as wide as the others. Costal fold absent.*

1. **E. nanana** Treitschke. Dark smoky brown; the head and thorax somewhat lighter fuscous. Fore wing with double whitish striæ, with paler fuscous areas between them; the striæ sometimes so broad as almost to obliterate the pale areas, and sometimes reduced to a narrow edging of single scales. Base perceptibly darker, bounded by an excurved line. An oblique median fascia, of the ground color, from middle of costa to inner margin, before anal angle; much less oblique than in *Z. pinicolana.* Outer margin also solidly of the ground color. A continuous black line in fringe, sometimes cut with white at M_1. Hind wing nearly concolorous. 9 mm. (*domonana* Kearfott; *piceafoliana* Kearfott).

June. Larva webbing terminal needles of spruce.

Maine to Ohio. New York: Portageville.

2. **E. cruciana** Linnæus. Black-brown, more or less heavily overlaid with clay-color or dull light ochre (in the Quebec specimen before me, mostly ochre). Two parallel oblique light fasciæ, one from middle of costa to outer third of inner margin, the other from outer fourth of costa to anal angle, both edged with heavy but broken silver lines. Two silver dots at apex. Base of fringe mixed black, brown, and white; outer part gray, white below apex. Hind wing mouse gray. 15 mm. (*augustana* Hübner).

July 6, 1916.

Megantic, Quebec; Europe.

The American form described above appears to differ a little from the European, and is probably a valid race.

3. **E. septemberana** Kearfott. Tawny brown with pink iridescence. A dull light gray area dusted with dark gray on inner margin from antemedial line to outer margin, over a third the width of the wing, into which projects a lobe of darker brown, covering the end of the cell. Fringe of the darker brown, with a pale basal line in the middle of wing; solidly pale at anal angle. The pale gray sometimes extending narrowly to the base. 18 mm.

September. The larva of a closely related western species feeds on crab-apple.

Essex County, New Jersey; Scranton, Pennsylvania.

4. **E. lindana** Fernald. Costal half of wing black-brown; dorsal half pale powdery gray, as in *E. septemberana;* the boundary clean-cut from the base nearly to the apex, forming two large rounded projections of the dark area with a pale one between them. 20 mm.

September. Larva on Cornus.

New Brighton, Pennsylvania. New York: Ithaca.

II. *Outer margin concave or notched at middle, the veins converging to the concavity. No costal fold* (Catastega).

5. **E. signatana** Clemens. R_4 and R_5 separate. White dusted with gray; in effect, very powdery light gray; head light, with outer side of palpi gray; thorax strongly mottled with gray. Fore legs blackish with white bars on tarsal segments and two bars on tibiæ. Fore wing with markings formed by gatherings of the dark dusting. Antemedial line obscure above, extended and strongly angled at lower angle of cell, and a little concave and irregular or straight below, preceded by a strong blackish shade, and ground nearly white beyond. Numerous oblique costal white and gray striæ from base to apex; the extreme base and apex gray. (The striæ extend a third the width of the wing toward the base, but outwardly are no longer, and hardly enter the cell.) Some more nearly solid gray shades below the tips of these striæ, extending from the tip of the blackish antemedial shade to the outer margin below the apex. Speculum obscure, preceded by a couple of black spots; often suffused into a blackish triangle on inner margin. Fringe cut with white below apex; with two gray lines, distinct toward apex. Hind wing ash-gray. 15 mm. (*Hedya* Clemens, *Catastega aceriella* Clemens.)

Sometimes this moth occurs in large numbers on the bark of trees in June. The larva forms a frass-tube in which it lives between two principal veins on the under side of a leaf of maple, and a silken web extending between the two veins, more or less crumpling the leaf. It eats only the parenchyma in the area covered by the web.

The name *aceriella* has priority but was based on the larva alone. This species and the next would form the genus **Catastega** Clemens, distinguished primarily by the peculiar larval habits.

Quebec to Pennsylvania. New York: Rock City (Cattaraugus County), McLean, New Windsor.

6. **E. timidella** Clemens. R_4 and R_5 separate. Fore legs banded as in *T. signatana.* Thorax powdery gray. Fore wing blackish; a large whitish area along inner margin, extending from basal angle to speculum, sharply defined above; quite narrow at base, to a third way out; where the boundary extends obliquely up to the middle of wing, then longitudinal in general direction, but sagging down in the midle, to the upper angle of the speculum, where it becomes ill-defined; the line defined above in the median area with black and below with very slightly raised silver-white scales. Costa outwardly striate as usual, the last stria almost cutting off a dark apical dot from the rest. Speculum whitish, dusted with light gray; with two broad, vague, silver bars, the outer one small; the whole preceded by two or three more or less confluent black spots, usually heavier than in *T. signatana.* A clear blackish line in fringe, cut here and there with white. 18 mm. (*Catastega* Clemens; *Gelechia.*)

May. Larva on oak in September; with the habits of *T. signatana*. Pupa in the ground.

Minnesota; Manitoba. New York: Crosby (Yates County), Ithaca (Cornell, bred), Bellport, Long Island (Dyar).

III. *Outer margin evenly rounded or stright; cell* Cu_1 *less than twice as wide as the others. Costal fold present in male* (Epinotia).

7. **E. solandriana** Linnæus. Ground varying from pale gray, sometimes coarsely striate with whitish, to fuscous or wood-brown. Antemedial right-angled at middle of wing; strongly oblique to costa and to inner margin; normally defined by a blackish bar before it on dorsal half (obscure in many specimens but always traceable); postmedial fascia perpendicular to this, from middle of costa to before anal angle; its dorsal half often filled with blackish and the rest obscure (it is regularly twice as wide at middle as above and below, but only part of the enlargment will be dark-filled); often a dark shade in apex. Space on inner margin between the two bands often filled with white, with a few dark points on the inner margin; or the two bands and the space between them may be covered by a black patch; or more rarely with a contrasting white ray from base almost to outer margin. *Outer half of costa, below, ochreous with four or five squarish fuscous patches.* 20 mm.

Caterpillar a bud-worm on various trees and shrubs, especially Amentiferæ.

Ottawa, Ontario to British Columbia; Europe.

8. **E. similana** Hübner. Dull brown, mottled with blackish; with some black dots toward apex. A rounded white patch at middle of inner margin; speculum white with a yellowish shade in middle. Fringe with a brown line, slightly cut with white. 20 mm.

September. Larva in hazel and birch. Our specimens are distinctly yellower than European ones and are possibly distinct.

New Jersey and north; Europe. New York: Pearl River.

9. **E. mediovirida**na Kearfott. Light dull gray, shaded with apple green; the median area almost solid green, especially toward inner margin; a blackish excurved basal line; antemedial line nearly erect, nearer base at costa, contrasting, black; wing outwardly with broken and confused fuscous striæ. Speculum obscure. Line in fringe faint, gray. 16 mm.

August and September.

Ottawa, Canada; western Pennsylvania.

10. **E. madderana** Kearfott. Ground pale mottled gray, shaded with old rose; nearly covered by three large rounded patches; the basal one slightly darker and yellower brown, from a third way out in costa to middle of inner margin, with evenly excurved outer margin; a large transverse oval patch over end of cell, reaching costa; and a contrasting bright yellow-brown patch resting on apex and outer margin, reaching almost to hind angle, with its inner boundary even, defined with white, and bent at a right angle below costa. 15 mm.

June and July.

Ottawa, Ontario; Illinois; Manitoba.

11. **E. laracana** Kearfott. Light gray, somewhat strigose; base darker, bounded by an angulate antemedial line which is practically obsolete above the middle, and concave on the lower half, where it is defined with blackish. A blackish shade in base of fold. A blackish oblique fascia from middle of costa to middle of disc, followed by a spot in the subterminal region. Costa blackish, with paired white striæ, outer margin gray with a dark spot at anal angle, but the rest of the inner margin strigose on a white base. Line in fringe black, cut with white opposite the cell, and weak below. Hind wing light gray. 15 mm.

April.

Cincinnati, Ohio. Types only seen. Probably the same as *E. celtisana*.

12. **E. vertumnana** Zeller. Wings unusually narrow; fore wing pale gray with slight bluish tint, lightly flecked with fuscous gray; rarely blackish. A slight blackish antemedial streak on dorsal half of wing, fading out above; perpendicular to inner margin; rarely heavier and practically reaching the costa. A similar heavier streak at two-thirds way to apex; oblique and a little excurved from just beyond middle of costa to inner margin at three-fourths way to anal angle, much thickened in the fold, and usually not quite reaching either margin; rarely thickened into a more even fascia, or sending a branch up from its outer side to Cu_2. Speculum with a few fuscous scales; line in base of fringe obscure, gray, and broken. 15 mm. (*celtisana* Riley, *xandana* Kearfott).

March. The type with thickened bands is much smaller (9 mm.) than the others, and may be distinct.

Cincinnati, Ohio; Missouri; Texas.

13. **E. yandana** Kearfott. Wing form as in *E. zandana*, of which it may be a darker variety. Ground crisply dusted and shaded with chalk white; blackish checking conspicuous, clean-cut, and in the outer part of the wing forming sparse, but strong, striæ, especially toward the costa. Antemedial band often a thick bar toward inner margin; postmedial band much thickened on outer side at fold, and usually sending off a spur toward the apex. 15 mm.

March.

New Brighton, Pennsylvania.

V. *Outer margin more or less concave, with veins converging to the concavity. Costal fold present in male.*

14. **E. zandana** Kearfott. Closely similar to *E. yandana;* cell Cu_1 twice as wide as the others, but notch in outer margin obsolete; slightly smaller; oblique fascia barely distinct; ground rather duller, dark smoky gray, dusted somewhat irregularly with black. Line in base of fringe broad, blackish, not contrasting. Hind wing dark mouse gray. 13 mm.

March. In this form the concavity of the outer margin is very slight, and it may be only a variety of *E. yandana;* in the remainder of the genus the concavity is marked.

Western Pennsylvania to Ohio.

15. **E. nisella** Clerck. Crisply powdered with brownish gray on bluish white; sometimes nearly evenly, showing only light and dark striation to the naked eye; usually with the base more or less contrasting, dark, its outer boundary sharply bent out at middle. Inner margin often brown in median area; speculum with a group of black dots or bars at middle of wing, and preceded by some black bars nearer inner margin; both sets obscure in the more evenly powdery specimens, and contrasting in luteous areas in the more contrasty ones. Lines in fringe obscure. 16 mm.

Larva in early spring on catkins of poplar, alder, birch, etc., falling to the ground with them, after which it is said to become a general feeder on the trash on the ground.

July and August. Extremely variable. Variety **pavonana** Donovan is the one with the brown patch on inner margin; in variety **decorana** Hübner the whole median area is yellow-brown, leaving the gray only on the base, apex, and speculum.

Generally distributed in Canada; western Pennsylvania. Europe.

16. **E. walkerana** Kearfott. Basal two-fifths blackish; with slightly excurved outer boundary, nearer the base toward the costa; median fifth white, toward costa filled somewhat strigosely with gray; outer two-fifths lighter brown with some short thick pale costal striæ; speculum a vague silver-gray area with some black dashes in its upper part, preceded by a black spot or two. A con-

tinuous dark line in fringe, cut with white below apex, brown rather than black 10 mm. (*hamptonana* Kearfott, in part).

Late July to September. Larva in catkins of hazel.

Pennsylvania. New York: Ithaca.

17. **E. hamptonana** Kearfott. Ground wood-brown, without any white patch; slightly darker patch before the speculum in place of the black dots; costal stria duller, and not continued by distinct gray lines; gray lines of speculum narrower than the enclosed space, which is heavily barred with black; line in fringe obscure and not crossed by a white stria.

Hampton, New Hampshire (types only known).

18. **E. momonana** Kearfott. Similar to *E. transmissana*, but smaller; white dorsal patch shaped almost as in *E. otiosana*, but not defined with black. Ground gray, varied outwardly with dull yellow-brown. Dark base with oblique outer boundary on lower half of wing. Speculum with two broad lead-gray bars, both regular and subequal in width (unlike *E. transmissana* and *otiosana*); filling of speculum ochreous, with four or five black bars. Costal and marginal marking and fringe as in *E. transmissana*. 13 mm.

July.

Ottawa, Ontario. I have seen a type.

19. **E. transmissana** Walker. Base dark brown or blackish, striate, with excurved outer boundary, median area white or with a white patch; clouded and striated with fuscous toward costa; followed by a rather triangular brown area resting on the inner margin before the speculum. Outer part of costa narrowly *brown* with geminate white striæ, defined with black; outer margin narrowly brown above, with a line below apex, running out through the fringe. Speculum confused, centering high up near the middle of the wing; mainly lead gray and white with black bars; a black line in base of fringe. 15 mm.

July. Larva perhaps on birch.

Northeastern States; Nova Scotia to Illinois. New York: Saranac Inn, Summit of Mt. Marcy, Rock City (Cattaraugus County), Albany.

20. **E. solicitana** Walker. Dull brown, striate with violet-gray; with a slight golden lustre at apex. Base mostly brown, with slight gray striation, its outer boundary markedly angulate at the middle; medial area broadly gray to middle of costa, and to beyond the second third of the inner margin, followed by an irregular oblique brown fascia. Costa outwardly with paired whitish striæ. Speculum of two more or less double silver-gray striæ, the ground between them brown with several black dots. Line in base of fringe black, cut with white. 12–15 mm.

May and June. Larva on white birch.

Seen from New Hampshire and Pennsylvania; type from Nova Scotia. "New York" (Fernald).

21. **E. rectiplicana** Walsingham. Head, thorax, and basal half of fore wing pure white; the fore wing with some gray flecking, especially along inner margin, and a large blackish splotch in fold. Outer half of wing mingled yellow-brown and blue-gray; the blue-gray shining in the speculum, where it takes the form of two broad, vertical bars. Filling of speculum yellow-brown, with black dots. Outer part of wing also with some white mottlings, especially along costa. Fringe fuscous with black basal line, white at apex. 13 mm. (*gallæsaliciana* Kearfott in part).

June in New York; November in California. Larva on willow.

Rocky Mountain and Pacific States. New York: Peru (Forbes).

A very distinct form which will prove to have a wide range in the North. The costal fold is slender and very long.

22. **E. signiferana** Heinrich (eastern form). Head and shoulders dark brown; thorax lighter, fore wing ash gray; the base somewhat darker, with oblique and excurved outer boundary; median fascia oblique out from middle of costa to

ore anal angle; rich dark brown above, fading out below; its middle connected apex by another less regular brown shade. A longitudinal black bar in outer t of cell and beyond, crossing the two brown fasciæ. 14–18 mm.
September 1.
New York; western States. New York: Hemlock Lake.
23. **E. heucherana** Heinrich. Black-brown; fore wing with some white streak- on the basal patch, a moderately broad, angulate antemedial fascia, and some ite streaks on outer part of costa. Fringe with a black basal line; smoky scous, cut with white below apex. Hind wing very dark brown, with paler nge. Head with white face, and base of palpi. 10–13 mm.
This may be a race of the western *E. ruidosana* Heinrich, from the same food, t it shows a genitalic difference.
Larva in a digitate mine in leaves of *Heuchera americana;* deep red, with ick head and cervical shield. Moth in May and June.
Rosslyn, Virginia (near Washington).

8. *ANCYLIS* Hübner

(*Ancylopera, Phoxopteris*)

Eyes moderate; palpi porrect, somewhat rough-scaled, or more rarely quite iry, often clavate, large. Wings smooth-scaled. Fore wing falcate, the outer argin usually concave from above M_1 to Cu_1; the concavity variable in character, it sharp and deep, as in Eudemis. All veins free; M_2–Cu_1 more or less approx- iate at margin. Hind wing with M_3 and Cu_1 connate or stalked.
Valve slender; cucullus sharply defined, slender; anal indentation usually broad nd smooth; sacculus only sparsely spined; costal hook weak or absent. Uncus ariable, bifid when present; socii very broad and hairy; gnathos slight, fused.
I use the names **Ancylis** and **Anchylopera** as indicated by Walsingham and urrant. In this country they have sometimes been interchanged, or, more often, ne genera have been united.

Key to the species of Ancylis and Anchylopera

1. Fore wing with costa white from base to apex.....6. *albacostana.*
1. At least apical part of costa brown or gray.
2. Fore wing with a white triangle on outer part of costa, enclosed by a heavy angulate blackish band.....8. *torontana.*
2. White outer costal patch not edged on lower side with blackish, or absent.[31]
3. Fore wing evenly brown to the speculum, which is contrastingly pale. 1. *tineana.*
3. Fore wing blue-gray and brown, with only costal striæ whitish. 3. *carbonana.*
3. Fore wing dull fuscous with only costal striæ whitish....4. *unguicella.*
3. Basal or medial part of wing with contrasting markings.
4. A longitudinal dark shade from base to apex; the wing light gray below it.
5. Shade sharply defined on lower side, forming two shallow scallops. 2. *diminutana.*
5. Shade diffuse on both sides, broken at middle of wing..5. *goodelliana.*
4. No shade from base to apex; base of inner margin dark.
5. Base of wing dark from costa to inner margin, with a well-marked, transverse, excurved or angulate outer boundary; ground of outer part of wing yellow or yellow-brown.

[31] A few Thiodias are likely to be sought here. They are distinguished by the white streak on the base of **Cu.**

6. Speculum absent; outer part of wing broadly yellow, with yellow fringe ..... 12. *divisana*
6. Speculum a vertical lead gray bar; fringe dark gray.... 11. *apicana*
6. Speculum a broad lead gray patch with a tooth on inner edge and enclosing a brown spot at margin..... 10. ————
6. Speculum a narrow angulated lead gray band, followed by mottled ochreous ..... 9. *cornifoliana*

5. Base of costa at most moderately paler than inner margin; the boundary diffuse; dark base below cell with strongly oblique outer boundary edged with a fine white line.
6. Yellow-brown ..... 13. *fragariæ*
6. Chocolate brown ..... 14. *floridana*
6. Umber brown ..... 15. *comptana*

5. Base of inner margin ochre-yellow, contrasting with the whitish base of costa, but not sharply set off from it..... 7. *platanana.*[32]
5. Inner margin gray, contrasting with the whitish costa, but with the boundary not sharply defined..... 7. *mediofasciana*

5. With a contrasting brown or blackish patch on basal half, more or less, of inner margin, with sharply defined boundary on upper and usually on outer side; the costal region pale and contrasting with it.
6. Basal patch followed by dark gray markings extending it almost to anal angle; median fascia on costa weak..... 1. *nubeculana.*[32]
6. Basal patch ending abruptly about middle of outer margin.
7. Fore wing without a marked oblique fascia from middle of costa, rarely with a pale clay-colored one; outer part of wing without any bright yellow or brown; basal patch gray-brown, lobed at its upper outer angle, extending far into cell. 2. *subæquana.*[32]
7. Fore wing with a conspicuous oblique median fascia from costa, or outer part of fore wing strongly shaded with ochre, or with a reddish basal patch.
8. Basal and outer markings of fore wing concolorous and blackish fuscous.
9. Median fascia broadening below into a fuscous blotch covering whole region of speculum, followed by a trapezoidal white patch on costa..... 3. *semiovana.*[32]
9. Region of speculum not suffused with a fuscous, the medial costal fascia followed by a pair of striæ.
10. Basal patch and fascia chocolate brown, with clay color between them; small (10 mm.).... 6 *angulifasciana.*[32]
10. Markings light fuscous on a whitish ground, only slightly tinted with clay-color; larger (15 mm.) 13. ————.[32]
8. Median fascia largely ochreous or paler, when the basal patch patch is blackish, noticeably paler than it is.
9. Basal patch blackish, contrasting with outer markings. 9. *burgessiana,*[32] 10. *murtfeldtiana.*[32]
9. Basal patch ferruginous brown or paler.
10. Specular region of fore wing typically with a small dark dot, sometimes even light gray; median fascia with its lower boundary sharply defined and rounded over, not containing distinct black dashes..... 5. *pulchellana.*[32]

[32] These species belong to Anchylopera.

10. Speculum without a dark dot, but frequently with more complex markings; median fascia normally diffuse below, and containing black dashes beyond cell.
11. Costa luteous toward base, concolorous with ground of outer part of wing; basal patch edged with black above, its outer boundary meeting inner margin in a long slant.....4. *maritima*.[32]
11. Costa whitish toward base, much paler than outer part of wing; outer boundary of patch meeting inner margin at right angles, the patch not outlined with black.
12. Basal patch on its basal half without defined boundary, fading into the cream-white costal area. 7. *platanana*.[32]
12. Basal patch defined, except sometimes at extreme base.
13. Fringe of fore wing below apex cream white, faintly suffused with ferruginous ochreous. 11. *laciniana*.[32]
13. Fringe of fore wing below apex dominantly ferruginous ochreous .....12 *fuscociliana*.[32]

Omitted from key: *Ancylis loricana; Anchylopera spiræifoliana, metamelana, disferana, dubiana, lamiana.*

I. *Hind wing with* M_3 *and* Cu_1 *connate or barely stalked; fore wing with apex rongly drawn out; the outer margin with a deep concavity, centering on* M_2

1. **A. tineana** Hübner. Brown with some silvery striation toward apex on sta; speculum white, shaded with light gray; terminal line dark brown; fringe low apex whitish. Hind wing dirty white. 15 mm.
April to July. Two broods. Larva dull gray-green with yellow-brown head; poplar and various Rosaceæ, in June and late fall.
Labrador to Massachusetts and Manitoba; also in Europe.
2. **A. diminutana** Haworth. Dull brown, shading into whitish on costa, especially toward base. Inner margin and outer margin below notch dull pale powdery ray; the upper boundary defined, and running in two shallow waves from base lmost to outer margin, where two lead-colored lines converge to its tip from sta. Apex wholly brown. 15 mm.
April to July. Larva on willow. The American records for *A. uncana* are robably in error for this species. *Uncana* is a little larger and has M_3 and Cu_1 talked.
Montreal, Quebec, and Vermont, to North Carolina and British Columbia; urope. New York: Peru, Black Brook (Clinton County), Crosby (Yates County).

I. *Hind wing with* M_3 *and* Cu_1 *more or less stalked, rarely stalked half way to apex.*

3. **A. carbonana** Heinrich (Kearfott ms.). Dark brown with patches of somewhat hining dark gray; a large area on basal half of costa, diffuse below; a band of gray long inner margin, abruptly widened at middle of wing, and there ending; two r three small gray patches in speculum; some smaller oblique bars beyond middle f costa; leaving the brown ground as an oblique fascia at middle of costa. Costa with many short blackish striæ, becoming silvery white toward apex. Fringe dark, with two heavy white bars below apex. 12–16 mm.
May and June.

[32] These species belong to Anchylopera.

Maine to Virginia, west to White River, Ontario.

4. **A. unguicella** Linnæus. Eyes smaller and palpi larger and more hairy tha in any other Ancylis. Shining violet-gray, strigose with blackish; basal thir more finely strigose, its outer boundary moderately excurved; a barely traceab darker fascia from middle of costa to before anal angle; fringe with whitis base, and cut with two white bars below apex. Hind wing paler fuscous. (*plag sana* Clemens.)

May; July. Larva on heath.

Labrador, Manitoba, and probably general in cooler parts of Canada; M Washington, New Hampshire, at 1,600 feet; Europe.

5. **A. goodelliana** Fernald. Whitish, dusted with light brown, with a diffus but contrasting brown shade from base to apex; usually nearly interrupted abo a third way out, where it crosses from the fold into the cell; broadening gradual to three-fourths way out where it abruptly narrows and is thence narrow an sharply defined to the apex. Costal striation light. Fringe pale except at ape Hind wings slightly browner. 15 mm. (Fernald says 28 mm., perhaps a mispri for 18 mm.)

May.

Maine to North Carolina and Washington.

6. **A. albacostana** Kearfott. Dull gray, becoming lighter blue-gray toward outer margin and blackish below the white costal stripe, which runs quite uninterrupte from base almost to apex, and is widest at about two-thirds way out. Outer margin white, except toward apex; fringe gray-tipped. 19 mm.

May.

Tryon, North Carolina; Colorado, in May. New York: Black Brook (Adiron dacks, June).

7. **A. mediofasciana** Clemens. Ground a mixture of dull gray and light blue gray, more or less mixed with white, especially toward outer margin. Costa third white, without definite boundary below, crossed by a blackish fascia a middle, as in *torontana* (which is perhaps an aberration of this species). Ape and apical fringe blackish; rest of fringe white.

May and June.

Maine to California. New York: Karner, Normaskill.

8. **A. torontana** Kearfott. Fore wing mottled gray (badly stained in the type which is the only specimen I have seen). Costa white from base practically t apex, with blackish dots along the costal edge; crossed by a broad oblique fasci at middle, and with a blackish shade below it, at least on outer part. 19 mm (*Proteoteras* Kearfott.)

There is some superficial likeness to *Proteoteras crescentana*, but the strongly falcate apex definitely places this species in Ancylis, where it appears very clos to *mediofasciana*.

Toronto, Ontario.

9. **A. cornifoliana** Riley. Basal half of wing dark gray-brown with some lead gray iridescence; the outer boundary of the dark portion right-angled at middl of wing; median fascia dark chocolate brown at costa, where it runs along th edge of the dark base and is strongly oblique; much broader below cell; separate from the dark base by a paler grayish patch, upright, and composed of a mix ture of yellow-brown and chocolate, forming a marked chocolate patch on inne margin. A gray band beyond the median fascia, strongly oblique in on costal half, and angled in below. Outer part of wing ochreous, with some golden lustre; the costal edge dark brown with paired whitish striæ. Fringe lead gray. 7–12 mm.

May and June. Not rare. Larva on blackberry, cornel, and birch.

General in distribution. New York: Ithaca, McLean.

10. **A.** ————————. Similar to *A. cornifoliana:* ground more evenly black- brown, the markings largely finely edged with clay-color; base strongly suffused with purplish gray, median gray fascia broad and fusing with the basal gray

ward costa; costal half of postmedial gray line almost longitudinal, the ground ocolate brown above it; lower half expanding into a broad diamond-shaped patch, closing a blackish marginal spot, and leaving only a narrow clay-colored mar- nal line beyond it. Fringe deep ochre, contrasting. Hind wing blackish. (*corni- liana* Murtfeldt).

May. Larva a leaf-folder on rose.

Hazelton, Pennsylvania; Missouri.

11. **A. apicana** Walker. Deep yellow-brown, becoming chocolate brown on basal ird and toward middle of costa. Thorax brown, head paler. Base of costal edge fore wing gray; a broad lead-gray fascia just before middle, of almost even idth and moderately angled at middle of wing; a lead-gray line from just beyond iddle of costa, obliquely out two-thirds of the way to the outer margin, then arply angulate and straight, almost paralleling the outer margin, to the inner argin; the angulation preceded by a few black bars. Costal edge outwardly ackish, with double white striæ. A black terminal line along middle of outer argin. Fringe dark gray. Hind wing mouse gray with pale fringe. 10 mm.

May and June. Larva on raspberry.

Nova Scotia and Pennsylvania to British Columbia. New York: Ithaca, McLean, renton Falls, Wellsville.

12. **A. divisana** Walker. Base deep red-brown, shading into violet-gray toward sta, and followed by a broad violet-gray fascia. Fore wing outwardly shading om light ochre to dull orange on costa, the speculum at most a slightly duller ale brown or cream area. Costa toward apex finely striate with gray, with a uple of white striæ close to apex. Fringe pale brown. Hind wing pale grayish rown. 12–15 mm.

May. Larva a leaf-roller on oak and sycamore.

Generally distributed. New York: Crosby (Yates County), Trenton Falls.

13. **A. fragariæ** Walsh and Riley. Ground tawny brown, cut into oval patches y bands of powdery violet-gray, which are narrowly edged with white. Base, s far as antemedial line, brown; the line fine, even, white; preceded by a blackish ade; strongly outwardly oblique from just below costa to **A**; then abruptly rving and meeting inner margin at right angles, beyond middle. Outer part of ie dull violet-gray with a long brown streak from middle of costa tapering to a oint just before the concavity in the outer margin; and with an oval longitudinal atch below it, more or less defined with white, the two often fusing into an regular patch. Fringe light brown; outer part of costa obliquely striate. 9 mm. *amblygona* Zeller).

July. Larva on blackberry.

District of Columbia to Louisiana and Colorado.

14. **A. floridana** Zeller. Deep reddish or chocolate brown; the basal patch and ntemedial line as in *A. fragariæ*; costa at base and band beyond the antemedial ne blue-gray, somewhat iridescent; outer part of wing toward costa chocolate tawny brown, finely striate with double white lines; middle of wing shading nto blackish; dorsal part lighter blue-gray or blackish. Fringe pale brown with arker tips. Hind wing mouse gray. 10 mm.

Larva on bearberry, and doubtless on other swamp Ericaceæ.

I have seen specimens typical of this form from New Jersey, Illinois, Missouri, nd Iowa; and it is doubtless wide spread, but generally confused with *A. comptana* r some undescribed species. It is injurious, at least in Iowa.

15. **A. comptana** Frœlich. Dull umber brown, the basal patch as in *A. fragariæ*, ut not as clearly defined with white. Ground outwardly lighter fuscous, without lue iridescence, the markings dull brown, without any yellow tint. Besides the blique costal bands separated by paired pale striæ, as in *A. floridana*, there is a ather comma-shaped dark patch on the middle of the outer part of the wing, and dark spot at the anal angle, the outlines of the two forming a well-marked double

whitish oblique stria toward the anal angle. Fringe fuscous, cut with two white bars at notch, below which it is crossed by a blackish shade, pale below.

Larva injurious to strawberries in Europe. Moth in May, in New Jersey.

New Hampshire; northern New Jersey; and perhaps widespread. New York: reported from Glens Falls, Nassau, and West Farms.

It is uncertain to what extent the injurious strawberry leaf-roller of this country is *comptana* or *floridana*, or one of two or three undescribed forms of the group which appear to exist. Specimens from Lakehurst, New Jersey, in the region of injury, are apparently constant and represent an intermediate form with practically the coloring of *floridana*, a little dulled, but with the outer patches of *comptana* distinctly marked. The same form occurs in Vermont and Manitoba and Colorado and has been confused with *Anchylopera angulifasciana*.

A. loricana Grote. Shining bronze brown, with bright yellow markings on outer part of costa and outer margin.

This species was described from Dayton, Ohio, but has not been rediscovered, and is probably exotic.

9. *ANCHYLOPERA* Stephens

(Restricted; *Ancylopera* auct.; *Ancylis*, in part; *Phoxopteris* in part)

Similar to Ancylis, but with M_3 and Cu_1 completely united (fig. 264). Palpi never as hairy as in some Ancylis. The falcation of the fore wing is always broad and well marked. Markings characteristic, a little modified in *A. nubeculana*. Fore wing with a dark basal patch not reaching the costa, and with its upper boundary curving into the oblique outer boundary; costa contrastingly pale. An oblique median fascia from costa to middle of outer part of wing, where it is usually somewhat widened and abruptly truncate, outlined on upper side with white, and usually also on lower outer side by a fine line which is often partly lead colored. Costa outwardly with white striæ, more or less distinctly paired; usually ending a little above the oblique fascia. Fringe usually dark at apex and pale below.

The genus is quite homogeneous and derived from the *comptana* group of Ancylis; for a key to the species, see Ancylis.

1. **A. nubeculana** Clemens. White; outer part of wing shaded with light gray; a short oblique bar at middle of costa. Apex shaded with brown, with a couple of black subterminal dots before the notch. A blackish patch on inner margin, with quite irregular upper boundary, extending nearly across cell at a third way out; ending at middle of wing, but followed by a patch of dark blue-gray which is hardly distinguishable from it. Fringe broadly fuscous tipped, cut with white below apex, and broadly white at anal angle. 15 mm.

Common and general in distribution in May and June. The larva a leaf-roller on apple and other trees, but rarely in injurious numbers.

New York: North Elba, Peru, Palmyra, East Bloomfield, Rock City (Cattaraugus County), Crosby (Yates County), McLean, Ithaca, Niverville.

2. **A. subæquana** Zeller. Ground white, slightly tinted with clay-color outwardly and especially toward costa. Basal patch brown-black, irregular, its outer part extending up into cell as a more or less obvious lobe. Median fascia from costa weak or obsolescent; when strongest, clay-color. Speculum frequently inconspicuous, sometimes defined by clay shades before, and beyond, and above it, the former crossed by some black lines. A black apical dot; fringe sometimes cut with dark gray at middle. Hind wing light gray. 15 mm.

June and July.

Nova Scotia to the West Coast, south in the mountains to Virginia; in the Northwest replaced by a grayer form, **kincaidana** Fernald. New York: Black Brook (Clinton County).

Easily distinguished by the peculiar form of the basal patch, and lack of yellow loring.

3. **A. semiovana** Zeller. Markings gray-brown with a slight golden iridescence, a white ground. Dorsal patch large, extending two-thirds way out on inner argin, evenly rounded, and followed by a white fascia. Outer half brown, from iddle of costa and from about three-fourths way out on inner margin; a large apezoidal white costal fascia at two-thirds way to apex, containing a very slight own costal stria; the costal striæ following it not distinctly in pairs. Speculum ot distinct. Fringe contrasting, pale. 13 mm.

May and June.

Canada to North Carolina. New York: Ithaca.

4. **A. maritima** Dyar. Clay-color, with a slight olivaceous tint, the markings lged with white. Dorsal patch long and narrow, the outer side strongly oblique, id ending at the tip of the anal vein, where the spot shades into the ground. ostal end of median fascia clearly defined, and lower end defined by a curved white ne; the fascia longitudinal in general course near middle of wing; the two black ashes in the outer angle of the fascia distinct. Costal striæ normal; apex ark; fringe concolorous. Hind wing mouse gray. 10–12 mm.

Larva in summer on beach pea; moth the following spring and again in August. he species will probably occur generally along the coast.

Kennebunkport, Maine, to Speonk, New York.

5. **A. pulchellana** Clemens. Ground whitish, shaded with light fawn; median ascia hardly darker, clearly defined on outer side by a silver-white line which orms a sharp angle opposite the notch; where it contains a couple of obscure rown dashes. Costal striæ fine, silvery, defining slightly darker yellow-brown ars. Speculum typically represented by a dark dot. Apex yellow-brown; dorsal atch yellow-brown, large and rounded. 13 mm.

May to July.

Massachusetts to Virginia and Illinois. New York: Ithaca.

6. **A. angulifasciana** Zeller. Ground dull luteous; dorsal patch and fascia blackish, he former rather short and wide, ending rather squarely on inner margin; the ascia broad, defined on outer side with an angulate dull silver line, with a couple f black dashes in the angle. Costa outwardly with irregular pale and dark short triæ, the ground of the whole outer part brown, but paler than the fascia. 8 mm.

May to July; late August. Larva on clover.

I have seen this species confused with *A. floridana*, from which it can be readily listinguished by the contrasting pale costa. It is easily recognized by its small ize and heavy, sharply contrasting markings.

Generally distributed and not rare, westward to Illinois and Manitoba. New ork: Crosby (Yates County), Ithaca.

7. **A. platanana** Clemens. Ground cream-white, including thorax and whole ase of wing. Dorsal patch defined only on its outer half, which is rusty ochre. Median fascia ochre, often interrupted by the cream-white ground, below costa; vith two or three heavy black dashes in the angle, and often another in the peculum, which is more or less suffused with ochre. Costal striæ light ochre, in cream-white area; all the markings tending to become diffuse. 10 mm.

Other specimens are larger and more diffuse in markings, with the dorsal patch lmost completely lost, and with the black striæ lighter. They may belong to *A. platanana*, but I suspect they are suffused forms of the *burgessiana* group.

June.

Apparently general in distribution. New York: Rock City (Cattaraugus County), Big Indian Valley, New Windsor.

The remaining names have been used more or less interchangeably for specimens n which the basal patch is well defined, of moderate size, and varying from yellow-rown to black in color; the fascia yellow-brown, usually markedly paler than the asal patch, defined on the outer side by an angulate silver or gray line, and con-

taining a couple of gray streaks in the angle; the costal striæ all paired, fi and short, on a yellow-brown ground, much darker than the whitish basal ha of the costa. The specular region is yellow-brown or yellow, and is darker tha the region just beyond the dorsal patch, but not sharply set off either from it from the lower end of the costal fascia. The apex is a little darker, the frin a little paler and duller brown. The hind wing is pale fuscous. I suspect th only one species, with a tendency to form numerous local strains, is represent in this series, but give the points of distinction as noted by their describers.

8. **A. spiræifoliana** Clemens. This is the oldest name of the series. As describe the fascia is slightly paler than the dorsal patch, both, however, being dark brow The patch hardly enters the cell, and its outer boundary is but slightly sinuou Larva on *Spiræa opulifolia*, folding a leaf longitudinally and living on the pare chyma within the fold.

Described from Pennsylvania.

9. **A. burgessiana** Zeller. Dorsal patch broad, variable in shape, brown, wit some golden gloss. Median fascia dark rusty brown, the whitish area before more or less dusted with gray. Outer part of wing rusty. Hind wing typicall blackish; nearly white in var. **pruni** Heinrich. 15 mm.

Type locality, Massachusetts. June and July. Larvae on oak and plum (*pruni*

New York: Rock City (Cattaraugus County), Ithaca, McLean, and Karne Generally identified with *murtfeldtiana*.

10. **A. murtfeldtiana** Riley. Small. Dorsal patch black-brown; median fasci yellower, reaching inner margin (though much paler below and diffuse on inne side), followed the whole distance by a whitish line, which is waved toward th inner margin. Speculum usually with a heavy black dash, preceded by a lea gray patch in the fascia. 12 mm.

May. Larva on oak.

Described from Missouri.

A. metamelana Walker is considered a synonym of *spiræifoliana* by Fernal The dorsal patch is blackish, the fascia red-brown, apparently not reaching th inner margin. 17 mm. Type locality unknown.

A. discoferana Walker. Dorsal patch and fascia both brown, costal striæ black This is also considered a synonym of spiræifoliana, but the dark coloring an small size (10 mm.) suggest rather *angulifasciana*.

11. **A. laciniana** Zeller. Patch and median fascia both ochre yellow, the win toward apex heavily shaded with ochre yellow; with distinct black dashes in th angle of the fascia and some black scales in the speculum. 15 mm.

Described from Massachusetts.

This form seems identical with the following:

A. dubiana Clemens. Cream white, with all markings ochre yellow except th two black dashes.

This form was described from Virginia. I have seen similar specimens fro Pennsylvania, Ohio, and elsewhere.

12. **A. fuscociliana** Clemens. Ground cream to light ochre; paler toward bas of costa; dorsal patch large and rounded. Fascia hardly darker on costa, quit concolorous below, and shading into the ground color; defined on outer side wit an angulate gray line, formed by the fusion of the first two costal striæ. Blac dashes in angulation of median fascia strong. Inner margin generally suffuse with dull brown beyond the patch; this suffusion slight in some females. Fring brown, duller than ground color. 16 mm.

June. Larva on chestnut and elm.

Generally distributed and not rare. New York: Rock City (Cattaraugu County), Crosby (Yates County), Ithaca, McLean, Trenton Falls.

This is hardly more than a subvariety of *burgessiana*, but appears to have a different range of food-plants.

13. **A.** ————————. Light gray-brown, with some faint yellow tint over paler rtions of outer half of fore wing. Markings as in *A. burgessiana* and *A. scociliana*, but easily distinguished by the lack of yellow or tawny. Costal iæ double, the first pair only moderately enlarged; fringe mixed whitish and h gray. 15 mm. (*spiræifoliana* Heinrich, not Clemens; *discigerana* Walker ?).

June and early July.

Parry Sound, Ontario, to Pennsylvania. New York: Newcomb, Rock City Cattaraugus County), Ithaca.

The specimen now standing as type of *spiræifoliana* is this, but as Clemens' pposed types were not labelled till long after his death I prefer to give more ight to his description, which is of a yellow-marked species.

A. lamiana Clemens appears to be *Ancylis floridana* Zeller. *A. parmatana* emens is not an Anchylopera but the species more generally known as *crispana*.

10. *NORMA* Heinrich

(*Epinotia* Kearfott, in part)

Similar to Ancylis; fore wing with apex strongly produced, but not actually ıleate, outer margin strongly concave. R_2 of fore wing arising from cell.

Valve simple, with several long ventral spines from margin of cucullus; sacculus ıinose. Uncus of two widely separated, weakly chitinized points. Socii long and road, ribbon-like.

1. **N. dietziana** Kearfott. Basal third blackish, median area white; outer two-fths heavily shaded with light blue-gray. Antemedian line only a little excurved, he dark base more or less strigose with pale gray. A dark gray spot in middle f wing two-thirds way to apex, often connected to inner margin by a lighter ray shade; some oblique gray striæ on costa; and apex shaded with dark gray, ith a black apical dot. A dark gray terminal line below notch, not reaching nal angle. Fringe mixed gray and white. 15 mm. (*Epinotia* Kearfott.)

May and June. Larva on Cratægus.

New Hampshire; Pennsylvania; Arizona. New York: Rock City (Cattaraugus County).

11. *RHOPOBOTA* Lederer

(*Eudemis* auct., not Hübner)

Similar to Ancylis; palpi large, porrect, and clavate; as in some Ancylis. Thorax practically smooth. Fore wing smooth, with R_4 and R_5 long-stalked (fig. 263). A deep notch below apex, to which M_1 to M_3 converge. Cu_1 widely separated n the typical forms; convergent, but not actually running to the notch in *R. licifoliana*. Hind wing ample, with R and M_1 approximate; M_3 and Cu_1 stalked; in male, with a patch of black sex-scales over costa and cell. Larva a leaf-roller; with black head.

Valve of male with a row of stout marginal spines; uncus bifurcate, weak; socii large, with ends fusing in a hairy knob.

1. **R. nævana** Hübner. Dull brown with two very broad bands of lead-gray and a shorter narrower one near outer margin. Costa outwardly with heavy, paired, lead-gray striæ, often connected with the transverse bands, especially in the female, but in the male usually separated by a streak of the brown ground. Almost always with a narrow antemedial gray band, 8 mm. (*vacciniana* Packard).

Larva on cranberry and other dwarf shrubs; sometimes injurious to cranberry, where it is known as the "black-head," to distinguish it from *Peronea minuta*.

Common, especially in peat-bogs; south to Pennsylvania, at least; also in Europe.

2. **R. ilicifolana** Kearfott. Dull fuscous, somewhat powdery and strig Inner margin contrastingly pale beyond middle; the boundary erect. Costa at second fourth, then more or less suffused with dark in the form of a broad angle whose apex is formed by a black spot at the end of the cell; this sl reaching from the middle of the costa to the apex. 10–13 mm.

June. Larva on terminal leaves of Ilex.

New Jersey, North Carolina, British Columbia. Heinrich considers this a f variety of *R. nœvana*.

12. *KUNDRYA* Heinrich

Similar to Norma. Fore wing with R_4 and R_5 completely united. R_2 ari from discal cell. Male with only one long ventral spine on cucullus of valve.

1. **K. finitimana** Heinrich. Fuscous brown, more ferruginuous toward apex fore wing. Base dark; a fairly broad antemedial and a median pale fascia, sc what scaled with lead color; speculum pale, with the inner bar leaden. Usuall black dot in apex; fringe fuscous with a black basal line. Hind wing d 9–10 mm.

Larva on *Ilex verticillata*. Moth in June and July. Pupa with large truding orange spiracles.

New Hampshire; Virginia.

13. *EPIBLEMA* Hübner

(*Eucosma, Pædisca,* etc., in part, with *Notocelia* Hübner)

Similar to Eucosma. Fore wing (fig. 265) normally with R_1 arising well be middle of cell. Hind wing frequently thickened at inner margin, with a more less distinct hair pencil; strong in *E. suffusana* (Notocelia Hübner). Thorax of tufted (figs. 278–279).

Male with valve bearing a small but distinct clasper; no strong anal or late spines on cucullus; anal indentation sometimes densely hair-spined. Costal f always present.

A few of the larvæ are gall-makers.

This genus merely represents the more primitive portion of the Eucosma ser and is possibly the most primitive of the Eucosminæ, rather than Hemimene; the spined abdomen of the pupa would indicate. As there is no superfi character to separate the species from Eucosma, they are included in the key that genus.

Key to the species

1. Fore wing with two or more contrasting blackish patches on a paler grou
   2. A triangular patch on outer margin, broader at costa, and an antemed one on inner margin ..... 8. *tanda*
   2. A triangular patch on outer margin, narrowing to both costa and in margin ..... 6. *culmina*
   2. A rounded patch resting on inner margin at one-third, and a smaller at two-thirds ..... 7. *brightona*
   2. A rounded patch at anal angle only; base dark with oblique outer bounda 4. *boxca*
1. No contrasting blackish patch along outer margin or at anal angle.
   2. Dark brown with contrasting pale speculum only.
      3. Smoky brown ..... 1. *strenua*
      3. Purple-gray and brown ..... 2. *abrupta*
   2. Otherwise marked.
      3. A clean-cut, irregular, oblique, white patch at middle of inner margin. 3. *otiosa*

3. No such patch.
4. Deep purple-gray and umber brown, with a clean-cut, contrasting, median white patch.
5. Patch covering a third of the area of the wing.....9. *tripartitana.*
5. Patch half as large.....10. *walsinghami.*
4. Lighter, at least outwardly; patch rarely well-defined.
5. Fringe concolorous, powdery gray; a small species..5. *abbreviatana.*
5. Fringe contrasting and dark, at least toward apex; anal angle often white like speculum.
6. Hind wing and outer third of fore wing whitish; the base of fore wing contrasting, blackish .....16. *illotana.*
6. Hind wing dark; fore wing darker, with much blue-gray, at least in postmedial region.
7. Speculum mostly white, connected with dorsal patch. 11. *dorsisuffusana.*
7. Speculum with broad blue-gray bands.
8. Fringe all powdery fuscous; base of wing white-scaled; speculum with a contrasting dark spot.....12. *carolinana.*
8. Fringe white at anal angle; base not white-scaled; specular region whitish.
9. Median area pure white; normally large species. 14. *kennebecana,* 13. *scudderiana.*
9. Median area pinkish white with scattered dark scales; speculum obsolescent .....17. *desertana.*
9. Median area somewhat pinkish or dirty white, with several strong gray striæ; speculum obsolete.....15. *obfuscana.*
9. Median area mixed white and gray, without pinkish tinge; speculum strong .....18. *suffusana.*

Unplaced: *E. hirsutana, E. ochraceana.*

1. **E. strenuana** Walker. Base of antenna sometimes black. Fore wing smoky brown, lightly and rather evenly dusted with luteous-tipped scales, except the dorsal part of the median area; which is sometimes much less dusted or clear. Antemedial line obscure, rarely fine; distinct and pale on dorsal half. A triangular area along outer half of costa and extending down on outer margin to M_1; striate with whitish, lead-gray, and often light brown; a pair of apical striæ palest, and often contrasting. Speculum a mixture of white and lead-gray, the white mostly in the upper outer portion, and containing some black dots; speculum preceded by a fine broken black line or a couple of dots. Fringe broad, the basal half powdery. 10–17 mm. (*flavocellana* Fernald, *minutana* Kearfott).

May to September. Larva boring in Ambrosia; typical specimens especially in *A. trifida*, and small ones (**minutana** Kearfott) in *A. artemisiæfolio.*

General in distribution and not rare. New York: Stanley, Poughkeepsie (New York State Museum), New York City (Watson).

2. **E. abruptana** Walsingham. Base of antenna inky black. A mixture of dark purple-gray, brown, and black, without contrasting markings on the general surface. Costa with some white striæ, a strong one just before apex. Speculum strongly contrasting, white and silver, with a suggestion of black streaks. A little yellow iridescence in the speculum and between it and the apex. Fringe above blackish and obscurely banded; white at anal angle. 13 mm. (probably *crispana* Clemens).

June.

Northern New Jersey; Virginia; Texas.

3. **E. otiosana** Clemens. Gray, shaded with blackish; the base blackish; with postmedial patches towards costa and on inner margin, separated by a narrow paler oblique gray band, as in *Sonia constrictana;* but often obscure, and, more

rarely, partly filled with white; the outer boundaries of the dark base inwa oblique to the dorsal margin; a white dorsal patch, filling the space between dark base and portmedial patch, usually irregularly quadrangular, with ant sides roughly parallel and cut off squarely in the middle of the wing; somet with a narrow extension between the two postmedial patches. Speculum gray with some black in the middle; costa with double striæ toward a 15 mm. (*Monosphragis* Clemens.)

June to September. Larva boring in pith and wood of stems of Bidens; hi nating as a larva in the dead stalks.

Common and general in distribution. New York: Peru, Ithaca, Big In Valley.

4. **E. boxcana** Kearfott. Dull gray-brown, shading into deep brown on i margin, especially between the median dorsal patch and the speculum. O half of costa with paler gray and darker brown oblique striations, fading below. Middle of inner margin with a contrastingly paler, sometimes whi patch, made up of four or five whitish striations, converging to their tips the middle of the wing, and more or less fused; practically as in sev Laspeyresias. Speculum contrasting, pale blue-gray, with a couple of black Base of fringe more or less powdery. Hind wing concolorous. 15 mm.

May.

New Hampshire to Texas and Iowa.

5. **E. abbreviatana** Walker. Pale gray, dusted with blackish, with a slight tint; base and outer part a little darker. Antemedial line obscure toward co erect, and a little irregular, below. A few geminate white striæ toward a Speculum of two vague lead-gray bands, with some black dots between th preceded by a brown area containing black dots. Fringe powdery gray. of the smallest of the genus. 10 mm.

May and June.

New Hampshire to Toronto, Ontario, and Missouri; south to the District Columbia.

6. **E. culminana** Walsingham. Light gray; strigose; the base slightly dar A rounded, triangular, deep brown patch resting on costal two-thirds of o margin, enclosing a pale gray marginal spot, and a small, subtriangular bl brown spot on inner margin before the anal angle, the space between the more shining. Fringe deep brown, contrasting, with black basal line; white the anal angle. Hind wing pale gray. Head and collar deep brown. 16 mm

August and September.

Massachusetts to District of Columbia, Manitoba, Washington, and Colora

This species approaches *Rhyacionia picicola* closely in appearance, but is smal with browner patches, and has a strong costal fold. Its dark head is a distinctive.

7. **E. brightonana** Kearfott. Wings broad. Grayish brown, with dark br patches; the one near the base of the inner margin large, as wide as high, strongly contrasting; a narrow oblique fascia from middle of costa to end of followed by some double pale costal striæ with dark streaks between them. Ap region brown, more widely on the costa where it contains a double pale st the brown tapering to a point near anal angle. A small spot on outer part inner margin. Speculum obscure, somewhat shining, with a vertical darker str in the middle. 12–15 mm.

August.

New Brighton, Pennsylvania. New York: Ithaca.

8. **E. tandana** Kearfott. Wings rather broad, dull gray, like *dorsisignata* A triangular blackish antemedial patch on inner margin, reaching up to the fo and a triangular apical patch; extending, on the costa, from four-fifths way to apex, and down to Cu on the outer margin; but separated from the ou

argin, except at apex and lower end, by a narrow strip of the ground color.
mm.
June and July.
Montclair, New Jersey, to Plummer's Island, Maryland; west to Illinois.
9. **E. tripartitana** Zeller. Dark purple gray, mottled with blackish; the distacter black spots more or less clearly edged with brown. Median area white cept for the costal fold of the male, which extends two-thirds way to the apex. ntemedial line erect, a little wavy, and rather nearer base on inner margin; ter boundary of median white area oblique and irregularly excurved, nearer se on costa. Speculum a vague blue-gray area, preceded by black dots in the ue-gray ground. 20 mm.
August. Larva in a gall on *Rudbeckia laciniata* and on Solidago.
Southern New York to Texas and Florida.
10. **E. walsinghami** Kearfott. Eyes rather small. Ground a confused mixture deep brown, purplish, and black scales, the specular region rather tending to ad-color, and sometimes with light brown striæ toward apex. Middle of inner argin with a large semi-elliptical white patch, formed of four partly fused striæ. ringe of fore wing coal black, with the usual black basal line not contrasting. 5 mm.
May.
Hemlock Falls, New Jersey (type); Oak Station, Pennsylvania; Alabama. New ork: Rock City (Cattaraugus County).
11. **E. dorsisuffusana** Kearfott. Black, somewhat shaded with dark gray. orsal half of wing white from a third way out, contrasting; the boundary somehat irregular and indented above at two-thirds, where the white area is divided y a group of black dots; a few black dots on middle of inner margin; outer part f costa brown, with paired white striæ; upper half of outer margin narrowly rown, cut with white at M_1, where the brown is preceded by a black dot; fringe ray above, whitish at anal angle. 20 mm.
In the male type, the black dots in the white area are almost lost.
June and July.
Cincinnati, Ohio.
12. **E. carolinana** Walsingham. Base and costa gray, with a slight blue tint, triated with blackish; medial area below middle of cell white or pale; outer part confused mixture of blue-gray and white, with a group of black dots at apex, nd two irregular vertical rows before the region of the speculum, finely defined with white. Fringe slightly powdery fuscous gray, without basal line. Hind wing mouse gray. 16–25 mm.
July and August.
Northern New Jersey to western Pennsylvania; south to North Carolina. New York: Ithaca.
13. **E. scudderiana** Clemens. Base dark purple-gray and blackish, the area darker and less extensive than in *illotana*, with sharply defined somewhat irregular outer boundary about a quarter way out; median area white, with a few gray striæ, light gray on costa; postmedial area mixed dull gray and light blue-gray, with some white; the speculum confused and slightly more white; preceded by a few black dots, one of them good-sized, and with a couple of fine black dots in its upper portion; a brownish area between speculum and apex. Fringe white toward anal angle only. Hind wing mouse gray. 20 mm.
Rather common. The larva bores in the crown or forms a slight fusiform gall in goldenrod; emerging the following June.
Generally distributed. New York: Lewiston, Buffalo, Ithaca, Albany, New Windsor.
14. **E. kennebecana** Kearfott. Fore wing white, shading into gray along costa; base dark gray, strigose with black; the antemedial line moderately angulate in

cell. Costa outwardly with paired fine white striæ; the ground toward a shaded with yellow-brown. Speculum silver and cream-white, with some bl scales; preceded by a region striate with black, and followed by a black b fringe light; the basal series of scales narrowly black-tipped, but hardly form a line. Hind wing mouse gray, paler at base between veins. 13 mm.

August. Type only seen. The veins in the fore wing are distinctly appro mate at the margin, which is concave.

Kennebunkport, Maine.

15. **E. obfuscana** Dyar. Base gray, transversely striate with blackish, its ou boundary about one-third way out, erect, and very slightly excurved; somewh diffuse. Outer part of wing white, striate with light gray, slightly more dens in the postmedial region. A black apical dot, and terminal bar at middle of ou margin; fringe dull black, whitish at anal angle. Hind wing dark gray. 16 m (*obfuscata* Riley, undescribed).

May to September. Larva in Solidago.

General in distribution. New York: Rock City (Cattaraugus County), Itha Clove Valley, Staten Island.

16. **E. illotana** Walsingham. Wings broader than in *scudderiana*. Base bla ish, mottled with dull black on blue-gray; outer part nearly white, the bounda diffuse and farther out on costa; wing shaded with light gray toward apex, a before anal angle; speculum represented by two or three black dots before ou margin; fringe gray on costal half. Hind wing nearly white. 15 mm.

May and June.

Probably generally distributed. New York: Kinderhook.

17. **E. desertana** Zeller. Basal third of fore wing blackish; strigose; w waved, erect, outer boundary; rest of wing white, with some gray striæ, gatheri to form a distinct gray and black triangular patch before the speculum, whi is a mere silvery patch, with an oblique gray line bounding it above, resting the outer margin. Terminal line and fringe blackish except at anal angle. Hi wing gray. 15–20 mm.

Larva in Solidago. Moth at end of May.

New York and District of Columbia to Texas. New York: Peru, Ithaca, N Windsor, Ramapo.

18. **E. suffusana** Zeller. Hind wing with a deep fold on upper side, below 3d a thickening between it and the inner deep margin, containing a hairy pencil ar ing near the base of the wing. Base, a postmedial patch toward anal angle, a apex dull gray; the medial area and speculum white, rather heavily shaded wi light blue-gray, more heavily than in *Eucosma scudderiana;* costal edge dark gr with double white striæ on outer two-thirds; some small black dots in speculu and a transverse series of stronger ones just before it; fringe gray toward ap white below; hind wing mouse gray. 16 mm. (*Notocelia* Hübner).

European specimens usually show considerable brown shading toward the ap and before the speculum, but more rarely are quite like the American strain, whi is probably introduced.

June. Larva a bud-worm on rose (fig. 278).

Maine; northern New Jersey, Maryland; Pennsylvania; Europe.

14. *EUCOSMA* Hübner

(With *Pœdisca, Steganoptycha, Halonota, Spilonota*, etc., in par *Euryptychia; Monosphragis* Clemens, etc.)

Palpi somewhat rough and beaklike (fig. 280); head rougher than in La peyresia and Hemimene, normal. Thorax smooth or tufted. Hind tibiæ wi a moderate amount of loose hair only. Fore wing normally rather lo

nd oblong, the outer margin typically smoothly rounded, but often concave n the middle, with M_1 to Cu_1 approximate toward margin. Apex rounded or acute, ever strongly falcate, but occasionally subfalcate. All veins separate, the separaion between M_2 and M_3 at base well marked. Male with a well-developed costal old; so far as examined, containing a hair pencil. Hind wing trapezoidal, normal, ithout sexual modification; R and M_1 normally approximate at base, never eparate; M_2 almost connate at origin with M_3 and Cu_1, which are stalked, or rarely nited.

Larvæ usually borers in the stems or roots of herbaceous plants, especially Compositæ.

The genus is too large and rather heterogeneous, but attempts to divide it ıave, so far, not been very successful. Presumably several genera are derived rom it by the loss of the costal fold.

The following key to species must be used with caution, as many species, specially of Epiblema, run very close. Females of Thiodia and related genera nust also be watched for; a few of these are included in this key for convenience.

Key to the Eucosminæ with costal fold

1. With extensive silver or pure white areas....2.
1. Not largely silvery or pure white....6.
2. Fore wing silvery with a brown St. Andrew's cross....6. *Eucosma adamantana.*
2. Fore wing with more complex markings....3.
3. A transverse median or antemedian silver fascia....4.
3. A longitudinal silver streak from base to end of cell....5.
3. Basal half white, with an incomplete brown fascia....29. *Eucosma grotiana.*
4. With an upright silver bar between the small basal spot and the fascia. 8. *Eucosma robinsonana.*
4. No spot between the basal one and the fascia....7. *Eucosma quinquemaculana.*
5. A single silvery costal median spot, extending beyond the end of the streak along lower edge of cell....9. *Eucosma ridingsana.*
5. An antemedial spot, almost reaching the base on the costa, as well as the medial one....11. *Eucosma hipeana.*
5. A single median costal patch, joined before the middle of the wing to the streak....10. *Eucosma argentifurcatana.*
6. Ground color largely bright green....9. *Epinotia medioviridana.*
6. Without green....7.
7. Speculum with a group of regular rows of black spots....8.
7. Speculum with three or four streaks or spots, or absent....13.
8. Area above speculum evenly buff....1. *Eucosma circulana.*
8. Area above speculum dusted with black or brown....9.
9. Base of fore wing evenly yellow, not dusted....10.
9. Base of fore wing, at least along inner margin, dusted with brown....12.
10. With transverse silvery gray bands toward base....5. *Eucosma fraudabilis.*
10. Base wholly yellow....11.
11. The area above the speculum, enclosed in a broken lead-colored circle, almost wholly dusted with brown....*Thiodia annetteana.*
11. Less than half of this area dusted with brown....*Thiodia refusana.*
12. Ground of apical half, and a streak in cell almost to base, yellow, not dusted. 2. *Eucosma scintillana.*
12. Wing almost wholly dusted with brown....3. *Eucosma dodecana.*
12. Basal fourth dusted with brown, contrasting....4. *Eucosma fratruelis.*
13. M_3 and Cu_1 of fore wing becoming coincident at outer margin. 19. *Eucosma cataclystiana.*
13. M_3 and Cu_1 separate....14.

14. Ground color bright yellow, almost without marks....22. *Eucosma bipuncte*
14. Ground pure white, but marked with blackish.. .....29. *Eucosma grotia*
14. Ground pure white on basal half of wing, contrasting with the brown api half .....21. *Epinotia rectiplica*
14. Ground color varying from cream to buff or bright ochre, with black scales speculum only .....
14. Ground brown, gray, or orange; or, if whitish, with considerable black scal on general wing-surface, or black marking.....
15. No speculum; fore wing lightly strigose with pale brown on pearl gray. 25. *Eucosma engela*
15. Speculum distinct, containing two or three black streaks or dots.....
16. Base and most of costa whitish, contrasting with the brown area about speculum .....32. *Eucosma gigantea*
16. Ground color usually yellowish, the outer part not much darker.....
17. Base, except toward costa, with scattered silver dots.....
17. No silver dots on basal half of wing.....
18. Bright ochre yellow, all white markings clean-cut and contrasting. 18. *Eucosma gracilia*
18. Pale ochre yellow, shading into cream, the marks in part ill-defined. 17. *Eucosma albigutta*
19. Cream-color; longitudinally strigose with pale gray. 20. *Eucosma pergandea*
19. With rounded pale yellow areas separated by bands of powdery light brown 21. *Eucosma pallidipalpa*
19. Buff with diffuse clay-color flecking.....20½. *Eucosma comatula*
20. With a distinct speculum, containing two or more black dots or streaks i pale area between two silvery or lead-gray bars, or with the specul represented by a silvery patch, preceded by distinct black dots, toward inner margin .....
20. No special marks at anal angle; at most, with a couple of silvery or le colored bands in species which have such markings on other parts of wing also; white anal patch, if present, not preceded by black dots.....
21. A white patch on middle of inner margin; sometimes lightly streaked w gray, but contrasting with the general surface; or with a larger whit area extending to anal angle.....
21. No white at middle of inner margin; the patch sometimes traceable but covered with gray striæ as not to contrast at all.....
22. Patch more than a third as long as wing, extending at least to the costal f and with sharply defined boundary.....9. *Epiblema tripartita*
22. Patch smaller or ill-defined on upper side.....
23. Speculum also a large and clearly defined whitish patch, separate from one on the middle of the margin.....8. *Epinotia simila*
23. Speculum not marked by a clearly defined patch.....
24. Outer part bright brown.....16. *Epinotia walkera*
24. Ground color all gray or dull brown, or with a very little brown at ou margin .....
[25. Vacant.]
26. White patch pure white, with clean-cut boundary all around, mostly defi with black; oblique and quite irregular.....3. *Epiblema otiosa*
26. Patch more or less ill-defined; when most contrasting, meeting the li brown shadings of the wing without any dividing line.....
27. Line in base of fringe black, clean-cut, and reaching (less intensely) to a angle .....
27. Base of fringe powdery or diffusely gray, rarely fuscous; fringe often wl toward anal angle .....

8. Antemedial line running obliquely in to inner margin; inner lead-colored band of speculum definite.....18. *Epinotia momonana.*
8. Antermedial line perpendicular to inner margin; inner lead-colored band irregular and broken.....19. *Epinotia transmissana.*
9. A triangular blackish patch more than 1 mm. wide at the middle, resting on outer margin .....6. *Epiblema culminana.*
9. No triangular marginal patch.....30.
0. Whole outer two-thirds whitish.....31.
0. Whole outer two-thirds not whitish.....32.
1. A squarish blackish patch before the speculum, as dark as the base; fringe blackish .....17. *Epiblema desertana.*
1. Area before speculum hardly darker than the ground; fringe blackish toward costa .....16. *Epiblema illotana.*
2. Dorsal area, between white patch and speculum, of the fuscous ground color, somewhat shaded with black.....4. *Epiblema boxcana.*
2. This area scaled with blue-gray and white; with clearly defined black dots .....33.
3. Speculum mostly white, connected with dorsal patch. 11. *Epiblema dorsisuffusana.*
3. Speculum with broad blue-gray bands.....34.
4. Fringe all powdery fuscous; base of wing white-scaled. 12. *Epiblema carolinana.*
4. Fringe white at anal angle; base not white-scaled.....35.
5. Base deep brown and blue-gray; median area strongly contrasting, white, with a few gray striæ.....13. *Epiblema scudderiana.*
5. Base of a less intense smoky gray and blue-gray; median area, half gray, less contrasting .....18. *Epiblema suffusana.*
6. Dorsum wood brown, contrasting with the blackish costal region; speculum of the lightest wood brown, with a single clear black dash in its upper portion .....15. *Eucosma rusticana.*
6. Dorsum not broadly wood brown, contrasting with a blackish costa.....37.
7. Wings blackish, the speculum a contrasting pale patch.....38.
7. Wings not solid dark with pale speculum.....39.
8. Terminal joint of palpus and second joint of antennæ black. 2. *Epiblema abruptana.*
8. Terminal joint of palpus not black.....1. *Epiblema strenuana.*
9. Deep brown, the speculum very obscure.....40.
9. Usually light grayish brown or gray; never brown with obscure markings....41.
0. Costal striæ at middle of wing blackish; region above speculum not dusted with white .....12. *Eucosma mandana.*
0. Costal striæ all geminate, whitish; region above and before speculum usually with pale-tipped scales.....14. *Eucosma fulminana.*
1. With sharply defined evenly colored dark patches.....42.
1. No such patches .....44.
2. Patches dark brown on a light brown ground, a third way out on inner margin and near anal angle.....43.
2. Patches at anal angle and along outer margin; blackish on a pale gray ground .....6. *Epiblema culminana.*
3. Somewhat less defined ones also at end of cell and along outer margin toward costa .....7. *Epiblema brightonana.*
3. With the two dorsal patches only.....19. *Thiodia tomonana.*
4. With a clear black line in base of fringe, usually interrupted with white opposite end of cell.....45.
4. Fringe powdery gray toward base, or, rarely, with a continuous light-gray line .....47.

45. Gray; the scaling wholly black and white, or with a brown patch on midd of inner margin.....15. *Epinotia nisell*
45. Brownish, with considerable brown scaling, especially along outer margin..4
46. Costal striæ conspicuous; outer two-thirds of wing pale gray.
20. *Epinotia solicitan*
46. Costal striæ obscure; some lead color toward apex..17. *Epinotia hamptonan*
47. With central area of speculum luteous, and a luteous irregular patch alo base of inner margin.....27. *Eucosma eumœ*
47. Without luteous markings along inner margin or in speculum.....4
48. Ground nearly evenly blackish; speculum surrounded by three dark lead-gr patches .....28. *Eucosma womonan*
48. Paler 4
49. Head and thorax conspicuously hoary.....5
49. Head and thorax nearly even brown.....5
50. Outer margin convex with a couple of black dots before speculum.
5. *Epiblema abbreviatan*
50. Outer margin concave; a dark vertical line or larger shade before speculum..5
51. Outer margin evenly concave on upper half.....5
51. Outer margin with a small notch, as in Proteopteryx....2. *Exentera improban*
52. Ash gray with contrasting dark base and oblique median fascia.
28.1. *Eucosma palabundana*, 28.2. *Eucosma fiskean*
52. Not so marked.....52½
52½. Speculum large, conspicuous; antemedial line concave below.
31. *Eucosma zomonan*
52½. Speculum obscure;; antemedial line all convex.....30. *Eucosma gomonan*
53. Postmedial patch on inner margin obliquely truncate and clean-cut abov separated by a narrow even oblique stripe of the ground color, from t postmedial patch at the end of the cell; or with the two patches fused in a fascia which is sharply indented on its basal side at the fold.
1. *Sonia constrictan*
53. Otherwise marked .....4. *Epiblema boxcan*
54. Hind wing bright orange.....26. *Eucosma graduatan*
54. Hind wing not bright-colored.....5
55. With sharply defined contrasting dark brown patches, but the base of the wi of the paler ground color.....5
55. Without such patches.....5
56. Two subequal dorsal patches only.....19. *Thiodia tomonan*
56. A patch near base of dorsum and one along outer margin toward apex.
8. *Epiblema tandan*
56. A large median patch like an inverted V, clearly defined on its lower part a strongly contrasting, but tending to fade out toward costa.
24. *Eucosma similan*
56. A conspicuous patch toward base of inner margin, and a dark, but not alwa clearly defined, patch over end of cell; the one at anal angle small absent .....24. *Eucosma dorsisignatana*, 5
56. A large patch on outer margin and a small one at anal angle.....5
57. Expanse 16 mm. .....6. *Epiblema culminan*
57. Expanse 30 mm. .....10. *Rhyacionia picicolan*
58. Height of antemedial spot more than one and a half times its width.
var. *diffusan*
58. Antemedial spot wider, often as wide as high.....Typical for
59. With a straight oblique shade from middle of costa to anal angle.
23. *Eucosma juncticilian*
59. A broad brown oblique median fascia, meeting another from apex at midd of wing .....22. *Epinotia signiferan*

9. No such shade ..... 60.
0. Ground color rusty orange ..... 61.
0. Ground color not orange ..... 62.
1. With a broad, evenly colored apical area ..... 10. *Epinotia maderana.*
1. With transverse pairs of gray striæ, as in Evetria ... 33. *Eucosma monitorana.*
2. With a white basal dash shaded below with black ..... 35. *Eucosma bilineana.*
2. No black and white basal dash ..... 63.
3. Ground largely whitish, or strigose with light blue-gray; the base darker .. 64.
3. Not dominantly white or heavily striated with white ..... 66.
4. Fringe dark on upper half of wing or toward apex only; hind wing of male mostly white ..... 16. *Epiblema illotana.*
4. Fringe and hind wing darker ..... 65.
5. Medial area nearly pure white; hind wing paler; fringe of fore wing almost solid dark ..... 17. *Epiblema desertana.*
5. Medial area with two or three strong gray striæ; fringe white on lower third; hind wing mouse gray in both sexes ..... 15. *Epiblema obfuscana.*
5. Median area with a white fascia in basal portion; hind wing dark brown. 23. *Epinotia heucherana.*
6. Fringe with a continuous black basal line ..... 67.
6. Fringe usually powdery gray toward base, without black basal line ..... 69.
7. Wings broader, ground deep brown; contrasting with the black line in the fringe ..... 1. *Epinotia nanana.*
7. Yellow brown with ochreous fasciæ ..... 34. *Eucosma tocullionana.*
7. Wings narrower; ground gray, not contrasting with the line in the fringe .... 68.
8. Dark smoky gray ..... 14. *Epinotia zandana.*
8. Light gray ..... 11. *Epinotia laracana.*
9. With an oblique lead-colored line running toward anal angle, converging with a similar subterminal one ..... 16. *Eucosma sombreana.*
9. No oblique lead-colored line ..... 70.
0. Ground blue-gray under a lens, appearing usually as two paired bands and an odd one ..... 30. *Eucosma gomonana.*
0. Ground not blue-gray ..... 71.
1. Apical third of costa, and outer margin to anal angle contrasting, pale, with an even, straight, dark-gray subterminal line ..... *Hystrichophora kokana.*
1. No even dark subterminal line ..... 72.
2. Brownish, flecked with little groups of white-tipped scales; expanse about 25 mm ..... 13. *Eucosma nandana.*
2. Much smaller, not hoary-flecked ..... 73.
3. Ash-gray, nearly evenly mottled ..... 68.
3. Whitish, with contrasting blackish transverse shades trisecting the wing .... 74.
4. Ground flecked with black ..... 13. *Epinotia yandana.*
4. Ground nearly even pale gray to blackish ..... 12. *Epinotia vertumnana.*

1. **E. circulana** Hübner. Fore wing light brown on basal half, light ochre on outer. With some small silver streaks and spots in middle of wing and near apex; a silver streak from costa at three-fourths of the way out to outer margin, curving in its outer part so as to leave a clear yellow semicircle above the speculum. Speculum of two horizontal rows of alternate black and silver spots, the upper row normally containing five or six spots and the lower reduced. Fringe powdery gray. 15 mm.

North Carolina and Louisiana to Florida. New York: Staten Island(?)

This species presumably occurs northward, but northern records, so far as I have seen the specimens recently, are based on other species of the group. The type is said to have come from Pennsylvania.

2. **E. scintillana** Clemens. Whitish, heavily dusted with brown, on basal half; light yellow on outer half. Base of inner margin less powdery than the general surface. A streak without the powdering, on the cell from base to middle of

wing. A silver bar across cell near end, and some smaller silver spots, but witho a distinct silver circle on outer part of wing. A silver subterminal line endi at middle of outer margin. Speculum with four vertical series of three bla spots each; with three vertical silver bars, one before them, one between the tw middle rows, and the other beyond; the region above the speculum heavily dust with black, and often in longitudinal streaks. 16 mm.

June; August.

I have seen this form only from Cincinnati, Ohio, Illinois, and westward. It w originally described from Pennsylvania. I suspect this is the "*circulana*" of mo eastern records.

3. **E. dodecana** Zeller. Dull powdery brown-gray, with only slight yellow streak along the outer margin. The pale streak in the cell faint or absent. Markin as in *E. scintillana*. 18 mm.

June. This is very probably a variety of *E. scintillana*; *E. randana*, from t Rocky Mountains, appears to be a larger race.

New York to Texas.

4. **E. fratruelis** Heinrich. Basal fourth powdery gray; second fourth de ochreous, bisected (toward costa) by a vertical lead-gray fascia; the ochreo fascia beyond it very narrow on the inner margin; outer part powdery gray; lead-gray median fascia from costa perpendicularly to top of speculum with little yellow beyond it at costa; speculum of five rows of partly fused black do (normally 2, 2, 3, 3, 2), the first and second separated by lead-colored bars, a likewise the third and fourth. Apex ochreous, bisected by a lead-colored fasci Hind wing blackish. Head, body, and fringe powdery gray.

July to September. Described from the types in the United States Nation Museum.

Southern Pines, North Carolina; Georgia.

5. **E. fraudabilis** Heinrich. Ochre yellow or yellow-brown, including head a thorax. Complete antemedial and medial lead-colored fasciæ, the antemedial at third way out; three silver dots beyond, the second outwardly oblique and runnin down along upper outer side of the very large speculum, which *almost* reach the costa; a lead-colored fascia on outer margin. Lower half of speculum wi six rows of black dots and three lead-colored bars; the upper part of the speculu with alternate cream-colored lines and series of black scales. Hind wing pal than in *E. fratruelis*.

June and July.

Skyland, Virginia; Southern Pines, North Carolina.

6. **E. adamantana** Guenée. Fore wing silver white, marked with golden brow fold in male brown; a brown fascia from middle of costa to outer part of inn margin, crossed by one from inner margin at a third way out, to apex, reachi the outer margin near the middle and running along it to the apex; dorsal ha of outer margin narrowly brown-edged; base of inner margin brown. 18 mm.

September.

Coastal marshes from New York to Florida.

7. **E. quinquemaculana** Robinson. Fore wing gray-brown; a silver-white sp at middle of base; a broad irregular transverse fascia at a third way out, twi as wide at costa as at inner margin; a rounded-trapezoidal patch on costa at tw thirds way to apex, and a smaller spot before the apex; a rounded spot opposite t postmedial patch, close to inner margin, but not quite reaching either the marg or the costal spot. 18 mm.

June; August and September.

Lucaston, New Jersey, to central Missouri, Arkansas, Louisiana, and Florid New York: Wells (New York State Museum); Bellmore, Long Island.

8. **E. robinsonana** Grote. Gray-brown; silver spot at base less distinct than *E. quinquemaculana*. An antemedial fascia a fourth way out not quite reaching t costa; a similar, broader one just before the middle of the wing, rarely reachi

costa, irregular on the outer side, and rarely widening toward the inner margin. e two outer spots on the costa much as in *E. quinquemaculana*, more nearly ıal. squarer, and each containing a minute brown dot on the costa; spot on inner ırgin further out, reaching the outer margin below, and less evenly rounded. A nute white streak on middle of outer margin. 13–18 mm. (*quintana* Zeller).
June and August.
New Jersey to Kansas, Alabama, Louisiana, and Florida.
Var. **tryonana** Kearfott, from North Carolina, is a variant with each of the o outer costal patches almost divided into a pair of bars, and the anal patch ·ided into a group of four partly fused spots. The antemedial fascia is even in dth and does not reach the costa. I have only seen the types, which were taken May.

9. **E. ridingsana** Robinson. Varying from pale ochreous to pale brown; the mark-gs finely edged with black. A silver streak through middle of wing from base end of cell, ending in a point; a silver streak along middle third of costa, leaving sta at two-thirds and ending in a point between the end of the first streak and e apex; a small costal dot beyond it; and a larger trianguiar patch before apex; irregular silver mark at anal angle, and inner margin silvery; a small silver iangle on costal half of outer margin. 20 mm.
A specimen from Illinois differs only in the silver costal streak extending prac-·ally to the base, and outwardly joining the two outer costal spots (*Conchylis* obinson).
August; September.
Manitoba to Illinois, Louisiana, and west.
Besides the two following, there are several other well-marked forms of this ·oup, which may be new species, or more local strains of *ridingsana*.

10. **E. argentifurcatana** Grote. Usually considered a variety of *E. ridingsana*, ıt at least a constant and clearly defined form. Similar to *E. ridingsana;* median ripe deeply notched on lower side; basal end of costal stripe curving down and ining it at the point where it is notched below. 40 mm. Not seen.
A form of this group from Southern Pines, North Carolina, and Texas agrees ith this, except for its much smaller size. (20 mm.) It has been taken from ugust to October.
Ontario.

11. **E. hipeana** Grote. Markings mostly as in *ridingsana*; costal streak divided ıto a bar on basal two-fifths of costa, fading out just before reaching base, and n oblique outer fascia starting at middle of costa, and running out obliquely cross the end of the cell, like the outer part of the costal stripe of *ridingsana*. 7 mm. This is also a possible form of *ridingsana*.
Port Stanley, Ontario.
A dwarf variant of this form also occurs in Nantucket, Massachusetts, North arolina, Illinois, and Texas; it flies in August and September.

12. **E. mandana** Kearfott. Dull brown, not powdery, lighter than *E. fulminana*. osta faintly striate with blackish on basal two-thirds and with lead-gray and irty white toward the apex; the last stria at the apex distinctly whitish, large, nd a little contrasting. A lead-colored line from costa at three-fourths way out, o outer margin about at M_2. Speculum somewhat paler, with two lead-colored ars, more nearly parallel than in *E. fulminana*; the outer bars broken, enclosing hree black longitudinal streaks. Fringe powdery white on blackish. Hind wing ouse gray; the extreme apex striate. 18 mm.
June.
New Jersey to Texas.

13. **E. nandana** Kearfott. Fore wing broad; outer margin slightly concave, but ıot notched. Fuscous, regularly dotted with little groups of white-barred scales; ıase slightly darker, its outer boundary oblique inwardly to inner margin; a

suggestion of oblique dark shades over end of cell, and opposite it at anal angle. Fringe concolorous; hind wing slightly paler. 30 mm.

September.

North Carolina to Manitoba.

14. **E. fulminana** Walsingham. Deep dull brown, practically the same shade as in *E. sombreana* and *mandana*; more or less, though usually only slightly, mottled in two shades; often with an area of narrowly white-tipped scales below and beyond the end of the cell, and some scattered white scales. Costa with geminate paler striæ, becoming distinctly whitish toward the apex; the last one nearly 1 mm. back from the apex. Speculum composed of two broad, vague, irregular, lead-gray bars, the outer one normally broken in two, with, as a rule, some black scales between them. Hind wing mouse gray. 27 mm.

Late July.

Illinois and Wisconsin to Texas.

15. **E. rusticana** Kearfott. Fore wing luteous on dorsal half and toward outer margin, including apex; shading into blackish on costa, except at the apex; the darker parts more or less streaked with black. Speculum a vague, paler, and grayer area, with a couple of long black streaks. Fringe luteous and light brown.

June; August.

North Carolina to Illinois and south.

16. **E. sombreana** Kearfott. Dull gray-brown, mottled faintly, and becoming a little warmer brown toward the outer margin; with geminate pale costal striæ; base slightly darker, with oblique outer boundary; a lead-colored line along outer margin, nearly meeting a shorter one at anal angle; with some black scales in the space between, but no definite speculum. Fringe powdery. 16–22 mm.

July and August. Larva in Helianthus.

New York to Manitoba, North Carolina, and Arkansas. New York: Ithaca, Brooklyn.

17. **E. albiguttana** Zeller. Pale ochreous, with scattered silvery gray spots of a few scales each; costa obliquely striate with whitish, the outer striæ lightly edged with black; speculum of two vertical silver bars, connected by three contrasting fine black streaks. Base of fringe dusted, black and white. Hind wing very pale gray. 12 mm. (*ochraceana* Fernald).

June and August.

New Hampshire to Virginia, Texas, and Kansas.

18. **E. graciliana** Kearfott. Doubtfully distinct from *E. albiguttana*; ground brighter ochre yellow; silver spots clean-cut and sharply gray-edged, as well as the striæ on the costa; one stria from the costa reaching practically to the outer margin, curving around the upper side of the speculum at a little distance. Hind wing darker gray.

July to September.

North Carolina.

19. **E. cataclystiana** Walker. M_3 and Cu_1 of fore wing becoming coincident at margin. Fore wing dull ochre, somewhat mottled, or more rarely, yellow-brown; costal striæ pale, somewhat silvery, distinctly defined with dark, the last one running along the outer margin, which is drawn out and subfalcate, about as in the lowest species of Ancylis. First silver bar of speculum slightly oblique, preceded by a brown shade and followed by two strong black dots; outer bar short, marginal. Base of fringe powdered, black and white. 16 mm.

Aberrant specimens have a brown ground color and the area above the speculum crisply dusted with white. In western specimens, the anterior bar of the speculum is more oblique.

August. Larva in Ambrosia.

Maine and Trenton, Ontario, to New Jersey, Colorado, and Utah. New York: Peru, Ithaca, Poughkeepsie; Clove Valley, Staten Island.

20. **E. pergandeana** Fernald. Pearl white, with pale gray striation, mostly longitudinal, but oblique on the costa except toward the apex, where the striæ converge ward the top of the speculum as usual, and are finely defined with black. eculum of two vertical rows of two or three black points, with faint vertical ver bars before, between, and beyond them. Base of fringe dusted with black. nd wing concolorous. 16 mm.

June and July.

Massachusetts to North Carolina, west to Colorado. New York: Peru; Lynbrook, ng Island, Gay Island (Long Island Sound). The paler race **flavana** Kearfott, curs in Arizona.

20½. **E. comatulana** Zeller. Buff-brown, coarsely flecked with clay-color; costodical portion of wing vertically barred, and speculum filled with the clay-color. nes mostly obscure; a strong lead-colored line from beyond middle of costa to low apex, separating the vertically barred region of the wing from the speculum. eculum with three black bars, partly broken into dots, but not crossed by a leadlored bar, the speculum with a vertical lead-colored bar on inner side and an blique one on outer. 15–18 mm.

May and August.

Woods Hole, Massachusetts, to southern California; rare in the East.

21. **E. pallidipalpana** Kearfott. Light brown, more or less mixed with white; ith brown and white costal striæ; and several round, pale yellow patches on asal two-thirds, two or three of them at the base fused into a larger irregular atch; all edged with white; speculum a silvery patch, divided by an irregular roken black line. Line in fringe nearly continuous. 10 mm.

July.

Connecticut to North Carolina, west to Iowa.

22. **E. bipunctella** Walker. Bright yellow; a brown dot at end of cell; fringe, bdomen, and hind wing brown. The yellow portion occasionally is suffused with ale dull brown except along the costa toward the base. Probably the largest and eaviest of our Tortricidæ. 35 mm. (*worthingtoniana* Fernald).

June and July. Larva in roots of Silphium.

Chicago, Illinois; Kansas and vicinity.

23. **E. juncticiliana** Walsingham. Light dull gray-brown; a nearly straight ine from middle of costa to inner margin just before the anal angle; the ground efore it much darker than beyond; sometimes with a blackish dot on this line t end of cell. Outer part with a large vague triangular dark shade resting on he outer margin. No definite line in fringe. 15 mm.

July and August. Larva boring in goldenrod.

Maine to Florida and California. New York: Otto, Ithaca.

24. **E. dorsisignatana** Clemens. Dark ash-gray, with a very slight violet gloss. Markings dark brown, even-edged, and finely outlined with a narrow pale line. Dorsal antemedial patch strongly contrasting, half-elliptical, and reaching up to he cell. Postmedial patch contrasting and sharply defined below, but vague on he inner side at costa, elliptical; almost reaching the inner margin where it sometimes joins a brown dot on the inner margin just before the anal angle. A faint brown fascia from costa to outer margin above anal angle, and a slight brown apical dot. No speculum. Line in fringe faintly darker. 12–20 mm.

September. Larva in roots of goldenrod.

New Hampshire to British Columbia and Texas. New York: Essex County, Dansville, New Windsor, Pine Island, New York City, Staten Island.

Variety **diffusana** Kearfott is on the average smaller and darker, with the antemedial dark patch alone contrasting, narrow, about twice as high as wide, oblique, and in many cases concave on the outer side.

Massachusetts to Illinois, North Carolina, and Tennessee. New York: Coram, Long Island.

E. similana Clemens is evidently locally constant and may be a good species. Antemedial and medial patches are fused into a thick L-shaped mark, which is sharply defined all around, except on the inner side at the costa. The small spot on inner margin before the anal seems to be always absent. (*confluana* Kearfott)

August. This form or species occurs with the type in New Jersey, but is apparently earlier.

Massachusetts to District of Columbia, Illinois, and Missouri. New York: Big Indian Valley.

25. **E. engelana** Kearfott appears to be a distinct species of this group, but the type is so rubbed as to be almost unrecognizable. Apparently it is rather narrow winged; dull gray-brown, with a dark antemedial spot on the inner margin as the most contrasting mark. It is likely to prove a synonym of *confluana* Kearfott. 15 mm.

August.

Pittsburg, Pennsylvania.

The female "type" from New Jersey is another species.

26. **E. graduatana** Walsingham (?). Fore wing dull gray; wings broader than in *E. dorsisignatana*; an antemedial half-oval spot resting on inner margin, and a large postmedial ellipse, reaching the whole width of the wing, from costa two-thirds way out to near anal angle. Outer margin dark brown. All the markings darker and finely defined with pale, as in *E. dorsisignatana*. Hind wing orange; abdomen brown.

May and June. The form here described is quite distinct from typical *graduatana* from Texas, and may be a new species.

Vermont to Manitoba.

27. **E. eumæa** Meyrick. Umber brown, more or less scaled with pale fuscous; the type with the basal half apparently largely pale fuscous, leaving a patch of brown in the fold. Costa with geminate whitish striations, becoming silvery below the costal edge; one of the striæ extending obliquely out almost to the outer margin, about at M_1, then sharply bent and running rather parallel to outer margin, to the inner margin; forming the outer line of the speculum. Inner line of speculum also narrow, silvery, and contrasting, the space between the two lines of the paler fuscous, crossed by strong black streaks. Fringe powdered; hind wing dark gray. 16 mm. (*wandana* Kearfott, not *vandana* Kearfott).

July. Type only seen, now in bad condition.

Cincinnati, Ohio.

28. **E. womonana** Kearfott. Black-brown, a little duller than *E. wandana*; vaguely mottled with areas of lighter fuscous dusting, the most definite one on irregular antemedial fascia, distinctly traceable only at the inner margin. Costa with paired striæ outwardly; speculum of three thick lead-gray patches, enclosing a narrow inverted Y-shaped portion of the ground, on which lie a couple of black spots. Base of fringe finely powdered with white. 15 mm. (*wandana* Kearfott, in part).

Maryland to Ohio and Texas.

28–1. **E. palabundana** Heinrich. Fuscous, powdery, and coarsely striate. Base dark, with some pale striæ, its outer boundary excurved, but strongly retracted in the cell below the dark costal fold. Antemedial area broadly pale, typically contrasting. A narrow, somewhat irregular and excurved, dark postmedial fascia, its upper part extending in obliquely to costa before the middle, its lower part lying along the speculum. Speculum with three broad, dull, lead-gray bars, leaving a small fuscous area between them, and perceptibly pinkish in some lights. Fringe powdery. 15 mm.

July and August. Described from an atypical specimen from Ithaca, probably representing a good race.

New York to Manitoba. New York: Ithaca.

28–2. **E. fiskeana** Kearfott. Ash gray, marked with darker gray-brown, somewhat mottled. Antemedial a broad dark shade resting on inner margin, defined on outer side; postmedial oblique out and excurved, preceded by contrasting brown shades over cell, and in and below fold. A blackish, diffuse, subapical patch. Speculum of three very broad, dull, lead-colored patches, with some black and buteous scaling between them. Fringe powdery gray, preceded by a white line above, and a black line opposite speculum. 20–29 mm.

June.

Virginia and Illinois to South Carolina.

29. **E. grotiana** Kearfott. Pure white; head yellowish; shoulders and disc of thorax blackish. Markings of fore wing dark brown; a brown band along the costal edge, from the base to the apex, heavier on the costal fold of the male. Antemedial fascia running obliquely up from the basal angle across the fold, very irregular and broken, and enclosing more or less white. Some dark brown striæ toward base. Postmedial fascia oblique from middle of costa to upper angle of the speculum, then widening to inner margin; with its outer boundary erect and inner boundary oblique inward. Speculum slightly shining, with three black points in its upper part. Middle of outer margin brown, with two pairs of white striæ. Fringe dark, its base powdery. Hind wing gray. 15 mm.

July.

Chicago, Illinois, and west.

30. **E. gomonana** Kearfott. Costal fold long. Fore wing dark gray-brown, in some lights with yellow-brown iridescence; with broad, partly confluent, light blue-gray, somewhat shining bands. A narrow basal band; antemedial fascia excurved, broad, and defining a darker base, partly confluent with the smaller, more erect medial one; postmedial band narrower, outwardly oblique, almost straight, leaving a high rectangular area of the ground before it on the dorsal half; a short gray bar across the apex, and a similar oblique bar at the middle of the outer margin; speculum indicated by two broad gray bands, sometimes with some black scales between them. 9 mm.

May.

Northern New Jersey to Virginia.

31. **E. zomonana** Kearfott. Light gray, slightly bluish, dusted with blackish. A blackish antemedial bar on dorsal half, more distinct than in *E. gomonana*, with a well-defined, sinuous outer boundary, and more diffuse inner and costal boundaries. Speculum paler than that of *E. gomonana*, composed of a group of three thick silver-gray bars, separated by a Y-shaped blackish powdery mark; with heavy blackish shades before and above it, the latter reaching half way to the costa. Rest of wing with the black dusting gathering into vague dark gray striations, leaving the apex blackish. 10–15 mm.

August. Very closely related to *E. gomonana*.

Pennsylvania to Illinois, Missouri, and Tennessee.

32. **E. giganteana** Riley. White, with a little gray toward base of inner margin and along costal edge. A large gray patch on inner margin from just beyond middle to apex of wing; the more basal portion of the patch with thick raised lead-colored bars; speculum finely dotted with black on a mixture of light brown and white, with a region above it of mixed powdery gray and white; above this a triangular region, extending up to the apex, of mixed gray and brown; fringe powdery. Hind wing light fuscous, with white fringe. 25–35 mm.

June to August. Larva in roots of Silphium.

North Carolina to Illinois and Missouri.

33. **E. monitorana** Heinrich. Deep brown, with a blood-red overcast. Head dirty white, fuscous behind antennæ; palpi fuscous. Fore wing with basal fourth of the ground color, scaled and shaded with lead gray, its outer boundary waved and farther out on inner margin; second fourth of wing broadly pale, mixed

silver and pale gray; median fascia of ground color, twice as wide at inner margi as at costa, normally enclosing a lead gray spot on inner margin, and interrupte on lower half of cell. Subterminal region pale, obliquely out from two-third way out on costa to anal angle, followed by a red-brown area with some whitis barring, especially on outer margin. Fringe with a weak dark basal line. Hin wing dark with a pale fringe. 15 mm.

Larva on pine, boring in the cones; moth emerging in May.

Pennsylvania; Virginia.

E. cocana Kearfott, described from North Carolina, can apparently be distinguishe by the darker brownish yellow head, heavily scaled with gray; and darker media fascia.

34. **E. tocullionana** Heinrich. Smoky violet-gray. Head ochreous, light in front thorax brown in front. Ground of fore wing striate with black and shaded wit brown; markings deep ochre or yellow-brown, broadly edged with dark silver, an broken into double striæ at costa; antemedial band of even width, oblique ou from a third way out on costa to inner margin at two-fifths, narrowed or inte rupted on fold, and tending to form two rounded spots. Postmedial band diffus on costal half, on dorsal half with a nearly round silver and ochre spot repre senting the speculum, without any black scales. Fringe dark, barred with white and with a black-and-white checkered basal line, hind wing dark. 15–18 mm.

Larva on Picea, boring in the cones; the moth emerging in May.

Connecticut; Pennsylvania.

35. **E. bilineana** Kearfott. Fore wing gray, powdery, and varying strongly i shade, dark specimens tending to be strigose with blackish and white. Base o **Cu** white, with a strong black shade below it; a finer black streak running up t apex; and often a diffuse streak in outer half of cell, with some whitish abov it. A series of dark terminal dots. Fringe concolorous. 25 mm.

July.

Hessville, Indiana, to Manitoba and Colorado.

14½. *HENDECANEURA* Walsingham

(*Enarmonia*, in part)

Similar to *Eucosma*. **Sc** of fore wing completely absent in male; R_1 arising from cell close to base, easily mistaken for **Sc**; female with **Sc** and R_1 normal M_2, M_3, and Cu_1 slightly approximate at margin, Cu_2 straight. Costal fold short. Hind wing normal, with **R** and M_1 stalked.

Male genitalia similar to Zeiraphera, but with the neck of the valve longer.

1. **H. shawiana** Kearfott. Deep brown, with some ochreous spotting; a more or less distinct white antemedial stria on inner margin; three irregular and more or less confluent striæ at middle of inner margin, continued above as a bluish metallic double fascia which reaches costa, ending in a few white scales on costal edge. Outer part of wing largely ochreous, but with a blackish subterminal shade between the two lead-colored lines above the speculum (opposite the notch). Speculum yellow with broken black bars. Costal edge outwardly barred black and white. 13 mm.

June. The larva is to be expected on the cone-scales of some conifer.

Hampton, New Hampshire; Newark, New Jersey.

Kearfott treats as a variety of this a form from Essex County, New Jersey, which is smaller (9 mm.), without decided ochreous areas, with the dorsal white spot less distinctly broken up into striæ, and the speculum quite obscure on account of the lack of yellow. Early July.

15. *THIODIA* Hübner

(*Pædisca*, in part; *Ioplocama* Clemens; *Semasia, Hedya, Cydia, Epinotia, Enarmonia*, in part)

Similar to Eucosma; R_2 generally nearer R_1 than R_3; costal fold absent; hind wing frequently with M_3 and Cu_1 completely united.

Valve not strong, and shorter than in Eucosma; anal indentation usually with a pronounced cluster of hairlike spines.

The venation varies, but there is always at least some slight trace of the emargination of the outer margin, and R_4 and R_5 are normally separate. The genus is perhaps heterogeneous, being derived from more than one source in Eucosma and possibly also from Epiblema. The usual food, as in those two genera, is the Compositæ.

Key to the species

1. Speculum of four rows of two black dots each.
   2. Area above the speculum (enclosed in a broken lead-colored circle) wholly dusted with brown.....1. *annetteana.*
   2. Less than half the area above the speculum dusted with brown..2. *refusana.*
1. Speculum less complex.
   2. With a rounded central dark patch on fore wing, defined below.
      3. Base of fore wing pale.
         4. Ground dull pale gray, with some darker dusting and brownish shading. 6. *Exentera virginiana.*
         4. Ground light ochreous.....5. *Exentera costomaculana.*
      3. Base of fore wing, at least toward costa, dark.
         4. Base of inner margin below fold contrasting pale gray, sharply separated from the black-brown costal portion.....4. *Epinotia lindana.*
         4. Base of inner margin concolorous, or gradually shading into the light red-brown costal portion.....3. *Epinotia septemberana.*
   2. No such patch.
      3. With a contrasting longitudinal white stripe in cell.
         4. Basal half of costa solidly white.....13. *striatana.*
         4. Basal half of costa finely striate with brown.....14. *clavana.*
      3. Costal third broadly white and more or less contrasting.....15. *kiscana.*
      3. No longitudinal white stripes.
         4. Inner margin contrastingly pale, the pale area sharply delimited in the median area .....6. *Epinotia timidella.*
         4. With a contrasting white antemedian or median fascia, preceded and followed with blackish.
            5. Fascia broad and complete.
               6. Followed by a blackish fascia, the ground outwardly pale. 1. *Gypsonoma fasciolana.*
               6. The whole outer half of wing dark....2. *Gypsonoma substitutionis.*
            5. Fascia confined to dorsal half of wing, and sometimes narrow and diffuse on outer side.
               6. Apex of fore wing with bright yellow-brown overlay or iridescence. 5. *marmontana.*
               6. Apex blackish, concolorous with other dark portions of the wing.
                  7. Median dorsal white patch small and well defined, separated from patch at anal angle by more than its width.....3. *parmatana.*
                  7. Dorsal white patch, larger and more diffuse, separated from patch at anal angle by less than its width.....4. *alterana.*

4. Antemedial region not white; ground, if white, heavily dusted with blackish, appearing gray.
5. Dark, with more or less contrastingly pale speculum.
6. Ground red-brown, extending along costa to apex....18. *raracana*.
6. Ground black-brown.
7. Apical region contrasting, yellow.....16. *ochroterminana*.
7. Speculum only with deep yellow filling, not conspicuous. 17. *perfuscana*.
5. Without contrasting pale speculum; or, if the speculum is somewhat paler, ground either powdery gray, or strigose.
6. Wing longitudinally striate with paler and darker, or tawny brown, and becoming darker toward apex; or moth large with almost evenly dull brown ground.
7. Speculum with three distinct black streaks between two lead-colored bars .....6. *formosana*.
7. Speculum less distinct or absent; sometimes with red-brown streaks.
8. Males (with single frenulum).
9. Tawny brown, shading into chocolate brown..7. *ferruginana*.
9. Ground luteous.
10. Speculum obsolete, the region crossed by the uninterrupted luteous and brown striation of the wing. 12. *radiatana*.
10. Ground darkening and becoming solid brown toward outer margin; the outer silvery bar continuous, and lying in the solid brown portion, or interrupting the striations.
11. Ground outwardly yellow-brown, streaked and shaded with chocolate brown.....9. *umbristriana*.
11. Ground outwardly bright rusty orange, streaked with rusty brown .....8. *roseoterminana*.
10. Speculum with well-marked basal and outer lead-colored lines, and preceded and followed by distinct blackish areas.
11. Blackish area at anal angle clean-cut above, stopping about at Cu_1.....10. *essexana*.
11. Blackish area extending up to middle of wing and there joining the dark area above the speculum. 11. *awemeana*.
8. Females (frenulum multiple).
9. Speculum indicated by lead-gray bars before and beyond it, usually distinctly paler and preceded by a dark shade. 10. *essexana*, 11. *awemeana*.
9. Basal lead-colored line of speculum absent, its ground concolorous.
10. Ground even-colored, a little deeper at anal angle only. 12. *radiatana*.
10. Ground of outer half decidedly deeper than base.
11. Fringe contrastingly powdered with blackish and white. 9. *umbristriana* (?)
11. Fringe concolorous with ground of wing. 8. *roseoterminana*, 7. *ferruginana*.
6. Fore wing heavily marked with green.....(Proteoteras).
6. Fore wing pale yellowish, shaded and dusted with gray or brown.

7. Ground pale lemon yellow.
8. Costa appreciably barred with fuscous only on outer half. 21. *olivaceana.*
8. Costa barred from base to apex.....22. *verniochrana.*
7. Ground light ochre.....20. *imbridana.*
6. Gray, with two contrasting blackish patches on inner margin. 19. *tomonana.*
6. Ground gray, powdery; or dark fuscous, without brown or yellow markings; expanse over 10 mm.
7. Two prominent, obliquely placed raised tufts in fold. 6. *Gretchina bolliana.*
7. At most with a small continuous scale-ridge in fold.
8. A gray line in middle of fringe.....23. *tarandana.*
8. Dark line in fringe, when present at its base.
9. A clearly marked, curved, angular, black marking above speculum, shaped like a bird's beak. 5. *Gretchina deludana.*
9. No such markings; with several blackish shades when there is any decided black marking above speculum.
10. Fore wing shaded with brown, at least in certain lights.
11. Smaller (14 mm.); hind wing white at base. 3. *Gretchina watchungana.*
11. Normally larger (18 mm.); hind wing all light fuscous. *Exentera* species.
10. Fore wing dark gray or blackish, heavily dusted with white, and without brown scaling or iridescence.
11. Face contrasting blackish; posterior tufts blackish. 1. *Gretchina amatana.*
11. Face concolorous or pale.
12. Thorax whitish, contrastingly but diffusely spotted with dark gray; fore wing powdery looking to naked eye; face whitish....5. *Epinotia signatana.*
12. Thorax light, white-mottled; face darker, fore wing light, powdery-looking, and with an indication of the Laspeyresia lunule at the middle of the inner margin ..... (*Laspeyresia garacana*).

1. **T. annetteana** Kearfott. Basal half of fore wing dull ochre, shaded with light brown; outer half powdered with light brown and white, with some ochre and lead-gray streaks extending down from white points on the costa; the boundary between the base and outer part also marked by a lead-colored fascia. Outer half of wing nearly covered by a large circle, brokenly outlined with lead-gray; its upper half filled with the white-dusted ground, the lower with four rows of black spots; each row composed of two large spots, and often a third spot below them; with a short, lead-gray bar between the second and third rows. Base of fringe also dusted with white. Hind wing light brown. 15 mm.

April.

Rhode Island; Ohio; Texas.

For points of distinction from the similar species of Eucosma, see the key to Eucosma.

2. **T. refusana** Walker. Light ochre-brown, shaded with gray; with pale streaks along costa, on **Cu,** and in cell. Outer part of wing with a large lead-gray broken circle, as in *annetteana,* and with some lead-colored costal striæ on the ochre ground. Upper half of circle with an area of brown, white-tipped scales, but only half filled with them; lower half with four rows of black spots, each row con-

sisting of two or three spots; and a lead-gray bar between the second and third rows. 15 mm.

April and May; September. Perhaps not rare, but confused with members of the *circulana* group.

Hudson Bay district to Virginia, west to Manitoba. New York: East New York, Long Island.

3. **T. parmatana** Clemens. Dull blackish, sometimes with some scattered whitish scales and with obscure black marks. Costa with some paired white striæ on outer half. Middle of inner margin with a white patch or a group of strong striæ, the most basal being strongest and defining the dark basal area. Speculum mixed white and silver, with a couple of black dots, its inner boundary erect, much straighter than usual. Base of fringe dusted with black and white. 10 mm. (*crispana* Kearfott etc., not Clemens).

June to September.

New Jersey to Missouri and probably generally distributed. "New York" (Edwards).

4. **T. alterana** Heinrich. Similar to *T. parmatana*. Ground somewhat paler fuscous; white markings more extensive, the median patch frequently diffuse on upper and outer side, its inner side and the speculum sharply defined. Apical region concolorous fuscous, cut, as usual, by fine paired white striations. 9–12 mm.

August.

Massachusetts to Maryland. New York: Ithaca.

5. **T. marmontana** Heinrich. Similar to *T. parmatana*. Fore wing with ground perhaps slightly richer brown, the costal edge toward apex and upper part of outer margin overlaid with shining yellow-brown in favorable light, interrupted by the paired white striæ, which are defined with black.

July and August.

Manitoba. New York: Ithaca.

6. **T. formosana** Clemens. Male clay-color, striate or heavily shaded with brown; costa obliquely streaked with silver on outer two-fifths, the last streak parallel to outer margin and at a sharp angle to the others. Speculum well marked, yellow, almost surrounded with silver, and with three black streaks. Basal line in fringe weak. Hind wing mouse gray with outer part of fringe white. Female with the same markings, but almost wholly suffused with brown; with slight or no pale striation. Costal silver streaks weaker, and fringe more tinted with brown than in male. 20 mm.

End of May to June; locally not rare. This species is closely related to the type of Thiodia (*aspidiscana*).

Quebec to New Jersey. New York: Rock City (Cattaraugus County), Ithaca, McLean, Karner, Ramapo, Watchogue.

7. **T. ferruginana** Fernald. Sexes similar. Rusty brown, shading into chocolate brown outwardly; fringe concolorous with outer portion of wing. Speculum represented only by a couple of streaks of rather more shining scales. Hind wing chocolate brown, with paler fringe. 13–15 mm.

May and June.

The male of this species is easily recognized, but the female cannot be certainly distinguished from *T. roseoterminana*; it is usually smaller and brighter than the latter.

Maine to New Jersey. New York: Black Brook (Clinton County), Rock City (Cattaraugus County), Ithaca, McLean, Staten Island.

8. **T. roseoterminana** Kearfott. Male clay-color, lightly and irregularly streaked with light brown; the strongest streak below the cell. Outer part of wing shading into rusty orange, streaked with rust-brown. A continuous chocolate-brown terminal band, not contrasting, preceded below by a slight lead-gray streak. Fringe concolorous with outer part, or a little paler. Female with basal half rusty orange shading into chocolate brown outwardly, with the same marginal mark-

ings as the male; fringe yellow-brown. Hind wing dark mouse-gray, with pale fringe. 18 mm.

Late May. This species of this group are hopelessly confused in all collections; especially the females.

Certainly known only from Cincinnati, Ohio.

9. **T. umbristriana** Kearfott. Closely similar to *T. roseoterminana*, but a little duller and darker in both sexes. Base of fringe dusted with black and white in both sexes. 16–18 mm.

May and June.

I believe Kearfott had the females of these two species exchanged, to judge by the cotypes before me.

Western Pennsylvania to Manitoba.

10. **T. essexana** Kearfott. Male clay-color, streaked with brown, the streaks emphasized and partly fused in such a way as to form a dark streak from base to outer margin above speculum, roundly notched by the pale speculum. Outer two-fifths of costa with an irregular pale-outlined patch, containing three well-marked darker pale-outlined costal spots. A heavy brown-black terminal line and a patch at anal angle before speculum, extending up to Cu_1 but not joining the central shade. Speculum almost completely outlined with silver, and with some brown streaks. The female will probably show similar markings, but not contrasting, on a deep brown ground. 20 mm. (*radiatana* Kearfott, 1903, not Stephens).

The larva bores in stems of aster, hibernating as a larva and emerging in May.

New Jersey.

11. **T. awemeana** Kearfott. Similar; the longitudinal streak stopping short before the middle of wing; the shade before speculum not decidedly blackish, extending up, though paler, to costa, before the peculiar outer costal mark, and joining a dark shade between the speculum and the costal mark. The latter shade, as seen under a lens, is formed of a couple of dark streaks. Speculum fairly well defined, but crossed by brown streaks. Terminal band brown, not blackish as in most specimens of the preceding form. Female chocolate brown, decidedly strigose with yellow-brown; base not much paler, but with the shades much as in the male, less contrasting, more diffuse, and often connecting to form a dark cross. 18 mm.

May and June.

New Hampshire; New Jersey; Manitoba. New York: Crosby (Yates County), McLean, Ithaca.

12. **T. radiatana** Stephens. Male clay-color, strongly striate with brown, forming a more or less marked darker shade from base to middle of outer margin. Speculum obsolete, marked by a few shining scales. Dark streaks heavy and tending to fuse on outer margin, and especially at anal angle. Fringe also dark gray. Female deep yellow-brown, with similar markings in black-brown. 20 mm.

End of May to June; not rare, being probably the commonest species of this series.

Generally distributed. New York: North Elba, McLean, Big Indian Valley, Ramapo, Bronxville, Oyster Bay.

13. **T. striatana** Clemens. Light gray; costa white from base to apex, only the outer half cut by light gray lines. A white streak shaded below with blackish, covering the lower edge of the cell to its end; a more or less distinct blackish streak on Cu_2, shaded above with pale. Speculum with a white spot, edged above and below with black streaks. Fringe powdery gray. 15 mm.

End of May.

Common and generally distributed in grassland; flying up by day, about like the similarly marked species of Crambus. New York: Peru, Oswego, Portage, Crosby (Yates County), Karner, Nassau, Ramapo, New Windsor, Katonah.

14. **T. clavana** Fernald. Fore wing light powdery blue-gray, the basal half light brown except on the inner margin; costal edge white, more narrowly so toward the base than in *T. striatana*, and cut by brown bars its whole length, those on the basal half finer and shorter than those outward. A white band along lower edge of cell, outwardly broken into streaks extending to the speculum, and with a black dash below it ending abruptly at the middle of the wing. Speculum pale yellow, preceded by a fine black line and containing a couple of dots. Apex drawn out as in *T. striatana*. Hind wing brownish gray; fringes pale. 15 mm. (I have seen this species labelled *tenuiana* Walsingham).

Hampton, New Hampshire; Truro, Massachusetts. "New York" (Heinrich).

15. **T. kiscana** Kearfott. Nearly even, pale gray. Wing form as in *T. striatana*. Fore wing with costa broadly but a little diffusely white; outwardly strigose with luteous and blackish; the white extending halfway across the cell on the basal half, but narrower outwardly. Inner margin more or less shaded with whitish; speculum white or pale yellow, preceded by a broken black line and containing two black bars. Fringe powdery. Hind wing with dark veins. 12 mm.

End of May and June.

Cincinnati, Ohio; New Jersey; District of Columbia.

16. **T. ochroterminana** Kearfott. Dull black; roughly scaled; outer fifth, including fringe, contrasting ochre yellow, somewhat mottled, preceded by a yellow-brown streak on dorsal half of wing. 10–15 mm.

August and September.

Kennebunkport, Maine, and Maryland to Manitoba and Illinois. New York: Potter Swamp (Yates County), Ithaca.

17. **T. perfuscana** Heinrich. Deep brown, mottled, made up of black-brown, chocolate brown, and some flecks of paler gray-brown; speculum lighter, deep ochre, flanked by two vertical lead-gray bars, and containing three black lines. Antemedial band broad, strongly excurved, formed of a gathering of the fuscous flecking; postmedial traceable at costa only. 12 mm.

August.

New York and western Pennsylvania. New York: Ithaca.

18. **T. raracana** Kearfott. Red-brown or, more rarely, chocolate brown, shading into light red-brown toward base, especially on costa. Costa with light gray-white striæ. Speculum contrasting pale yellow, with broad silvery bars and some broken black markings. Fringe powdery gray at apex, light yellow-brown below. 12 mm.

This form can be distinguished from the similarly marked Eucosmæ by its brown or reddish, rather than fuscous, color. In pattern it is very near *T. formosana*. It has been taken in August, and, southward, in May also.

New Jersey and western Pennsylvania to Texas and Florida.

19. **T. tomonana** Kearfott. Pale gray, somewhat strigose with duller light gray; the speculum represented by some black dots. Two contrasting blackish spots on inner margin, the basal one half-crescentic, the outer half-elliptical or more irregular, extending less than a third way across wing, but broad. 12 mm.

August and September.

St. Johns, Quebec; New Jersey; western Pennsylvania. New York: Ithaca.

20. **T. imbridana** Fernald. Ground pale yellow, overlaid, except toward base of costa, with rusty ochre; mottled irregularly with dark brown, with a strong purple iridescence in some lights; the purple-brown gathering to form a band from the middle of costa to inner margin before speculum, and another from this band where it crosses the cell to inner margin at a third way out, both sometimes broken up or obscured by brown suffusion. Outer part of costa also showing the yellow ground, and striate with brown. Speculum luteous with three broken black bars. Hind wing light gray.

General in distribution; flying in August.

21. **T. olivaceana** Riley. Light lemon yellow, with a slight green tint, marked with light chocolate brown, so overlaid with yellow as to appear gray; the markings are largely longitudinal streaks, the principal ones being a broad one along lower side of cell to middle of wing, one below basal third of costa, a narrow and clean-cut oblique one from middle of costa to speculum, a small spot on inner margin a quarter way out from base, and a large patch at anal angle; besides some small streaks on costa and a vague dark shade through outer part of wing. Speculum yellow, with some black dots. Fringe concolorous.

June to August.

New Hampshire to District of Columbia and Illinois. New York: Rhinebeck.

22. **T. verniochrana** Heinrich. Similar to *T. olivaceana*; palpus with a fuscous spot on outer side of second joint. Fuscous bars on costa of fore wing distinct from base to apex. 10–13 mm.

August.

Massachusetts; New Jersey.

23. **T. tarandana** Möschler. Light gray, powdered on a white base, with clear white streaks, and with the pattern more or less defined with silvery white. Antemedial band strongly oblique outward from beyond basal angle to middle of cell; light gray-brown, shaded with blackish on the fold; postmedial irregularly excurved and widening toward inner margin, running from middle of costa to outer third of inner margin, where it connects more or less distinctly with a similar narrow and irregular terminal band, three fuscous spots on costa outwardly, defined by white striæ. Speculum enclosed by the irregular silver lines defining the postmedial and terminal bands, filled with slightly yellowish white, mixed with gray, and with a few black scales. Fringe white with a gray center line. Hind wing darker gray. 25 mm.

August.

Manitoba, Labrador.

16. *SPILONOTA* Stephens

(*Tmetocera* Lederer; *Eucosma,* in part, Walsingham and Durrant)

Male without costal fold. Palpi beaklike, triangular, with third joint concealed in scales. Thorax smooth. Fore wing practically smooth-scaled, with outer margin concave at middle and M_3 and Cu_1 somewhat approximated toward the margin. Antennæ with notch more widely open than in Strepsicrates and nearer base; the segments concerned in it almost completely fused and difficult to count.

Valve very long and narrow; cucullus with a large apical spine. Uncus absent; socii short and broadish; gnathos weak.

A development of Thiodia.

1. **S. ocellana** Schiffermüller. Dull grayish brown, somewhat mottled; the median area typically contrasting dirty white, in variety **lariciana** Heinemann hardly paler. Basal area with outer boundary roundly and moderately angled. Outer margin shaded with gray-brown near apex; below, with about three black bars, followed by a gray streak; a black spot before anal angle, made up of partly fused dots, with a well-marked gray shade between it and the three black bars. Dark line in base of fringe grayish and not contrasting. 12–15 mm. (*pyrifoliana* Clemens).

Often injurious, the larva webbing together the opening buds of apple in early spring. Moth in June to early August.

General in distribution; also in Europe. Possibly introduced in this country. New York: Common and general.

17. *STREPSICRATES* Meyrick

(*Phthinolophus* Dyar, *Eucosma*, in part, Walsingham and Durrant)

Palpi rather clavate, scaled, with prominent short porrect third joint. Thorax smooth. Fore wing with outer margin rounded, the cell with a heavy scale-tuft in fold at one-third way out. Costal fold of male very large. Hind wing with M_2 markedly separate from M_3 and Cu_1 which are stalked, R and M_1 approximate. Male antennæ with basal segments of shaft more or less fused and distorted, about the sixth to tenth joints forming a notch, partly covered by a scale tuft.

Male genitalia similar to those of Spilonota. Pollex present; anal angle spinulose; cucullus with several marginal spines. Socii small and slender.

1. **S. indentanus** Dyar. Normally with costal two-thirds of wing brown, quite variable in shade, and the dorsal third paler gray, often contrastingly pale, especially in males; the boundary wavy and more or less defined with black. Hind wing mouse gray. 12 mm.

July. Larva a leaf roller on Myrica. The Florida species on guava appears to be distinct.

Canada to Florida. "New York" (American Museum of Natural History).

18. *SONIA* Heinrich

(*Eucosma*, in part)

Fore wing with costal fold present in male. R_4 and R_5 completely united; outer margin concave, with M_2 to Cu_1 approximated; Cu_2 straight; R_2 arising near R_1 from the normal accessory cell; R_1 from before middle of cell. Hind wing with R and M_1 often anastomosing and sometimes stalked.

Male genitalia similar to those of Suleima; clasper rudimentary; socii short and broad.

The single species is almost identical in pattern with *E. perplexana* Fernald, from the Gulf strip, but the latter has R_4 and R_5 separate.

1. **S. constrictana** Zeller. Ground light brown-gray; when fresh, with distinct violet iridescence; markings deep brown. Base deep brown; antemedial line perpendicular to inner margin, except toward the costa where it often fades out; straight or slightly excurved below cell; an irregularly quadrangular dark brown patch on inner margin toward anal angle, with its upper boundary oblique and parallel to the lower boundary of a similar patch over end of cell; typically with the two patches fused, and the point of fusion marked by a strong notch on the anterior side of the combined patch, at the fold; postmedial patch on cell sharply defined on basal and lower sides, but above shading into a brown outer costal shade, which surrounds the upper sides of the speculum; costa with pale paired striæ outwardly; speculum blue-gray with some brown in center. Fringe powdery. 12–15 mm.

June to August.

Northern New Jersey to Florida, west to South Dakota and Texas.

19. *SULEIMA* Heinrich

(*Thiodia*, *Semasia*, in part)

Similar to Sonia. R_3 arising from middle of cell or slightly beyond; costal fold absent; notch on outer margin variable. Hind wing with R and M_1 always stalked, M_3 lost. Clasper absent.

1. **S. helianthana** Riley. Whitish gray. Fore wing with two quadrate blackish patches on inner margin, and a black dash and white triangle at the apex. Base

somewhat darker, with a paler space between it and the first blackish patch; speculum white, containing a black dot, and on its costal border two longitudinal black lines, and partly defined with brown. Fringe sometimes dusted with blackish. 15–20 mm.

Caterpillar forming a gall on Helianthus. Moth flying in Texas in August.

Maryland to Texas, west to California.

2. **S. cinerodorsana** Heinrich (Kearfott ms.). Fore wing with costal two-thirds blackish, dorsal third grayish white, the boundary irregular and diffuse; outer third light wood-brown. Speculum white, with some small black spots, between two very broad silvery bars, edged before, above, and beyond, except at anal angle, with the wood-brown. Some dark gray and whitish striation on outer part of costa; one stria extending obliquely across the apex, the rest short and unequal. Fringe powdery gray, darkening to the apex. 13 mm.

July and August.

Maryland, Pennsylvania.

20. *RHYACIONIA* Hübner

(*Evetria* of authors, not Hübner; *Retinia* Guenée)

Palpi short, roughly clavate, with long, scaled, porrect third segment (fig. 283); thorax smoothly scaled. Fore wing rounded (fig. 270), with oblique, excurved outer margin; the radials all separate, R_1 from middle of cell, R_2 rather nearer R_3 than R_1, M_2 straight, connate or shortly stalked with M_2, except in the *comstockiana* group, in which it may be perceptibly curved and well separated at origin; M_3 curved. No costal fold. Hind wing as in Eucosma. Valve simple, pollex present, uncus absent, socii and gnathos weak or absent. Markings characteristic, formed of slightly raised shining silver gray transverse lines, edged with white, at least at the costal edge, in most of our species on an orange ground.

R. comstockiana may run by the key to Charlotta, but by its genitalia, habits, and pattern belongs here. The palpi also are normal for Rhyacionia, and slightly aberrant for Charlotta.

The larvæ are of three types. Typically they bore in terminal twigs of pines, very often working in the leader. Some species kill the shoots outright, often causing the tree to fork; others, like the introduced *R. buoliana*, distort it, resulting in a tree with a crooked trunk. Some are seriously injurious, especially in nurseries, where the only remedy seems to be hand-picking the affected shoots, which show an exuding mass of pitch. The second group, **Petrova** Heinrich, live in pitch-nodules on the twigs; and the third, **Barbara** Heinrich (which contains no described eastern species) bore in the cones of spruce.

Key to the species

1. Ground dark gray.
   2. Head gray; fore wing evenly strigose.....9. *gemistrigulana.*
   2. Head orange; fore wing with two rounded blackish patches..10. *picicolana.*
1. Ground gray out to end of cell, the terminal third, more or less, yellowish.
   2. Male antenna heavily ciliate; gray area on inner margin reaching almost out to anal angle.....4. *busckana.*
   2. Male antenna lightly ciliate; a tawny patch in fold below end of cell, the solid gray extending only about to the middle of the inner margin 5. *adana.*
1. Ground red-brown or orange, at least on outer half of wing.
   2. Terminal space gray (except toward apex), or at least crossed by three heavy oblique gray striæ.....2. *frustrana.*
   2. Terminal space red.

3. Transverse lines single, narrow, covering less than a third of the surface of the wing.....1. *buoliana*.
3. Transverse lines strongly doubled, covering more than a third of the surface of the wing.
4. Terminal band with a yellow band before it.....3. *rigidana*.
4. Terminal band preceded immediately by the outermost gray stria.
5. Base heavily striate with gray.....6. *comstockiana*.
5. Base red-brown with a few whitish striæ.
6. Basal line in fringe red.....7. *virginiana*.
6. Basal line in fringe black.....8. *albicapitana*.

I. M_2 *straight, connate or stalked with* M_3. *Larvæ in buds; group* vii *with three setæ* (Rhyacionia).

1. **R. buoliana** Schiffermüller. Bright orange, typically irregularly shaded with yellow, with six or eight narrow anastomosing pale silver-gray transverse lines, slightly edged with white at costa only. Fringe light gray-brown, with a blackish line formed by bars near the tips of the first row of scales. Hind wing light gray-brown, with pale fringe. Head yellow and tegulæ red with powdery gray tips. 18–26 mm.

The larva bores in the tips of pine shoots, causing them to grow crooked.

Europe; occasionally introduced in nurseries. New York: Great Neck, Westbrook, Nassau, and Lynbrook, Long Island.

2. **R. frustrana** Comstock. Ground deep red, changing from crimson to red-brown, the thorax and base of wing shaded with blackish. Outer part of wing with four broad bands of silver-gray, obscurely divided by series of blacker scales, the last series terminal, except toward the apex, where it forks and one branch runs subterminally to the costa, the other remaining terminal, but falling short of the apex; sometimes with whole apical region gray, or with the gray broken into three bands, the uppermost one crossing the apex. Ground mottled with yellow patches, the dorsal half of the median area usually solid yellow, but with a narrow antemedial band toward costa. 10–13 mm.

Larva boring in terminal and lateral shoots of scrub pine and dwarfing them.

Nantucket, Massachusetts, to Florida and Texas; a larger race in the southwest. New York: Ithaca (Comstock), Karner (Felt).

3. **R. rigidana** Fernald. Fore wing similar to *R. frustrana*, the gray bands normally more extensive, the whole medial area whitish. Last gray band subterminal, followed by a yellow stripe and then a red terminal line. Fringe reddish purple. 18 mm.

April. Larva with the habits of *R. frustrana*, and apparently commoner inland, on *Pinus rigida*.

This species can be certainly separated from *R. frustrana* only by the genitalia.

New York to North Carolina. New York: Ithaca (Fernald).

4. **R. busckana** Heinrich. Grayish fuscous barred with gray-white. Head and thorax concolorous, the head with some reddish in vertex. Fore wing with outer fourth red, less on inner margin than at costa; a red terminal line and gray fringe. Hind wing smoky. 15 mm.

April.

New York to Pennsylvania. New York: Bellmore and Central Park, Long Island.

5. **R. adana** Heinrich. Similar to *R. busckana*; but with the reddish outer part invading the outer half of the inner margin, especially the region of the fold. 17 mm.

End of March and early April.

Massachusetts to Virginia.

II. M_2 *well separated from* M_3, *and normally curved. Larvæ nodule-makers with an extra seta on proleg* (Petrova).

6. **R. comstockiana** Fernald. Head white; thorax light powdery gray, including whole of tegulæ. Fore wing light orange, striate with shining light gray, with dense antemedial and medial groups of striæ, covering most of the surface on the basal half of the wing. Fringe pale gray-brown. Hind wing very pale gray-brown, often nearly white, with whitish fringe. 16–22 mm.

Larva boring in younger twigs of *Pinus rigida*, forming masses of pitch.

Nantucket, Massachusetts, to Virginia. New York: Ithaca (Comstock), Karner (Felt).

7. **R. virginiana** Heinrich. Head more or less yellow; thorax pale orange, shaded in front with whitish. Fore wing light rusty orange, without any yellow, and heavily striate with somewhat yellowish silvery double striæ; somewhat irregularly striate, but as heavily on outer as on basal part of wing. Fringe very pale brownish, practically concolorous with the striæ; with an orange basal line cut with white; hind wing white, shaded with pale wood-brown. 16–22 mm. (*wenzeli*, Kearfott ms.).

May. Larva forming a large pitch nodule on *Pinus virginiana*.

Southern New Jersey to Virginia.

8. **R. albicapitana** Heinrich. Light reddish brown. Head and front of thorax cream white; base of tegulæ and rest of thorax orange. Fore wing with striæ a mixture of silver and lead-gray, leaving a larger area of the ground free at end of cell; some black on costal edge, and black dusting on the striæ. Fringe lead gray with black basal line. Hind wing dark. 16–19 mm.

Larva in young branches of *Pinus divaricata*.

Fort William, Ontario, to Wisconsin and Saskatchewan.

9. **R. gemistrigulana** Kearfott. Black, with most of surface covered with pairs of pale gray striæ, about 16 in all. Thorax gray with blackish collar; hind wing lighter brownish gray. 18 mm.

The larva bores in slender shoots of *Pinus virginiana*, the infested shoots being marked in the winter by a ring of pitch.

North Carolina and south; in May.

10. **R. picicolana** Dyar. Head and front of collar rusty ochreous; thorax and abdomen light brown. Fore wing mottled and strigose in two shades of gray; outer margin and fringe dark, cut with white at anal angle. Base of costa darker; a round blackish spot on inner margin before anal angle and a patch along the outer margin from the costa nearly to the anal angle, with regularly curved inner boundary. Hind wing dark gray with white fringe. (Male not seen.) 30 mm. (Eucosma Dyar).

Larva in a pitch mass on trunk of Abies.

Wisconsin to Washington.

21. *PROTEOTERAS* Riley

Thorax tufted. Fore wing tufted; outer margin with a notch, and M_1 to Cu_1 closely approximated, except in *P. claypoleana*, where the emargination is slight; accessory cell and venation otherwise normal; costal fold absent. Hind wing with a black area of sex scaling near the costal margin, except in *P. claypoleana* where there is perhaps a slight suggestion of thicker scaling.

Valve characteristic, with a series of long, flattened, blunt spines on the outer face of the sacculus, near the margin, continuous with the usual marginal spines, and very weak in *P. claypoleana*, where they are about as in *C. ratzeburgiana*. Socii short and stout, finger-like, with a long hair pencil; gnathos free, as in Eucosma.

The known larvæ all bore in petioles and twigs of Sapindaceæ; in fact, that is

the principal reason for putting *P. claypoleana* in this genus rather than in Charlotta. Most of the moths are scaled with green.

Key to the species

1. Ground nearly white.....*7. obnigrana.*
1. Ground gray or greenish.
2. A blackish angulate bar from middle of costa to end of cell, and thence to apex .....*3. crescentana.*
2. No continuous heavy dark bar.
3. Costa and speculum white.....*4. naracana.*
3. Without broad areas of white.
4. Bright green, marbled with black toward base as well as outward; male without sex-scaling on fore wing.....*6. moffatiana.*
4. Duller green or gray; male with black scaling on fore wing; very little black at base of wing above.
5. Costa cut with an oblique dark gray fascia at middle; sex-scaling of fore wing below a small black patch.....*5. æsculana.*
5. Costa evenly powdery dull gray; sex-patch on fore wing below more diffuse, fuscous.....*2. willingana.*
4. A black dash in basal two-fifths of fold; no black sex-scaling.
1. claypoleana.

1. **P. claypoleana** Riley. Pale brownish gray, shaded heavily with sage green. Inner half toward base green, with a well-defined outer boundary, crossed by a black dash, which fades out at base; a black bar at base of inner margin. A green shade from tip of basal area to below apex, crossed by one from middle of costa almost to anal angle; both irregular and diffuse, and shaded with blackish where they meet; the blackish area extending outwardly almost to the outer margin. Hind wing mouse gray, with pale fringe. 16 mm. (*Epinotia, Enarmonia*).

This is the most primitive species of the series, having very slight wing-tufting, and the notch at the wing margin indistinct; but its appearance and larval habits place it here. The sex-scaling is present on the parts of the fore and hind wing which overlap, but it is concolorous and hardly visible.

Typically the young larva bores in the petioles of expanding leaves of buckeye; then deserts them, and feeds on the withered leaves; sometimes also in the flower.

Mississippi Valley.

2. **P. willingana** Kearfott. Pale dull gray, with a faint green tint showing under the lens; shaded and mottled with contrasting dark shades. Wing-tufts well marked; notch on outer margin strong. Fore wing with an area of fuscous scales beneath, from Sc to R_4; hind wing with black scales on upper surface above the hair pencil only; below, with a black costal streak almost reaching from base to apex. 16 mm.

June. Larva forming a gall in twig of Negundo, in May.

Maryland to western Canada and Kansas.

3. **P. crescentana** Kearfott. Dull light gray, with a contrasting blackish band which runs from middle of costa to end of cell, then turns abruptly, running to the apex; half as wide at apex as at middle of costa. Sex-scaling slight, at middle of costa of hind wing above and below. 17 mm.

June. Larva with *P. willingana* in box-elder.

Maryland to Iowa.

4. **P. naracana** Kearfott. Fore wing rather smoothly light olive green, with some black and brown toward apex. Costa with a broad and irregular white area, tapering to a point at apex; speculum mostly white. Sex-scaling on under side of fore wing at middle of costa slight; hind wing without black scales, but with a heavy brown hair pencil on upper side. 16–20 mm.

End of May to June.

Western Pennsylvania to Ohio.

5. **P. æsculana** Riley. Darker olive green, more or less mottled with yellow and gray, and with some small black markings. The most distinct gray areas being a darker fascia from middle of costa toward anal angle, becoming diffuse below, and a shade running to apex; often with a fine longitudinal black streak at their junction. Fore wing below with black sex-scaling in a contrasting patch a third the length of the wing; hind wing with sex-streak, below, lying well away from costa; above, with one on each side of the costal hair pencil. 12–18 mm.

June. The larva bores in the tender terminal twigs of maple and buckeye, in May, causing them to wither.

The distribution is uncertain, as a large part of the records for the genus have been reported under this name. The species appears to be general. New York: Ithaca.

6. **P. moffatiana** Fernald. Bright green, mottled with black, heavily on basal third and in the form of a curved band from middle of costa to apex. Sex-scaling only along costal edge of hind wing, below; hair pencil concolorous and inconspicuous.

June. Larva in petioles of maple.

Canada to Pennsylvania. New York: Ilion, Lancaster, East Aurora, Ithaca, Big Indian Valley.

7. **P. obnigrana** Heinrich. Fore wing dull white, with olivaceous basal patch, a fascia from middle of costa to anal angle, and a shade below costa near apex. A thin black line from apex to near middle of wing, curving as in *P. æsculana*. Sex-scaling of male diffuse, on under side of both wings, dark and fairly conspicuous. 16 mm.

Dublin, New Hampshire; type only known.

22. *GRETCHINA* Heinrich

(*Thiodia; Proteopteryx,* in part)

Thorax with dorsal tufts; fore wing with more or less distinct tufts or transverse ridges, at least in the fold. Outer margin concave, normally strongly notched, with M_1 to Cu_1 closely approximate at margin; R_4 and R_5 stalked or separate; R_1 from middle of cell; Cu_2 sinuate; costal fold absent. Hind wing with R and M_3 approximate. Fore wing gray, largely formed of a mixture of black and white, with a characteristic cusped black mark, more or less suggestive of a bird's beak, below the apex.

Valve simple; cucullus moderate; spined area reduced and lateral and anal spines strong; sacculus densely hairy on outer side. Uncus absent; socii markedly chitinized, triangular, porrected; gnathos reduced and partly fused with socii.

This genus is well marked superficially, really resembling only the Catastegas; but in the forms with R_4 and R_5 separate, the only real diagnostic characters are in the genitalia.

Key to the species

1. R_4 and R_5 stalked (fig. 260); tufting stronger as a rule.
   2. Hind wing white on basal half, contrasting with the blackish fore wing. ..... 3. *watchungana.*
2. Hind wing darker, pale only when fore wing is equally pale.
   3. Gray without any brown tint.
      4. Fringe with 3 or 4 light and dark bars at apex; otherwise mostly pale; a pale species ..... 5. *deludana.*
      4. Fringe with a single, strongly contrasting, oblique black bar in apex; a dark species with mouse-gray hind wing ..... 6. *bolliana.*

3. Outer part of wing shading to ferruginous brown.....4. *dulciana.*

1. R_4 and R_5 separate; hind wing not white.

2. Dark basal area complete to costa.....1. *amatana.*

2. Subcostal region pale to base, cutting off the darker basal area.

2. *delicatana.*

1. **G. amatana** Heinrich (Kearfott ms.). R_4 and R_5 approximate; R_5 to M_2 markedly curved; M_1 associated with the notch (unlike Exentera). Blackish, shaded with whitish, the dorsum beyond the antemedial band tending to show a rounded or broad triangular pale (whitish) patch, suggesting that of *Epinotia timidella*. Speculum of two very broad and dull bars, with a narrow line of the ground between them, often obscure, but normally pale, very often separated from the central patch by a distinct blackish bar. Fringe dark and obscurely barred, the longitudinal line in it usually more distinct. Hind wing dark gray, as in *G. bolliana*. 18 mm.

Moth locally common on tree trunks, in May and early June.

Forest Hills, Massachusetts, and south. New York: Ithaca, Crosby (Yates County), McLean.

2. **G. delicatana** Heinrich. Similar to *G. amatana*. Fore wing with R_4 and R_5 connate. Fore wing narrower, with the powdering more whitish gray, extending along the costal and subcostal region to the base, cutting off the darker basal patch; a tendency to a nearly continuous dark line from apex to upper side of cell, without the subterminal spot or hook of *G. amatana*. Hind wing paler toward base. 15 mm.

April and May.

New Jersey and Pennsylvania.

3. **G. watchungana** Kearfott. R_4 and R_5 very shortly stalked; fore wing a little rough scaled. *Blackish gray*, in some lights shot with brown, especially at apex; irregularly mottled with whitish. Costa with fine irregular oblique striation; inner margin with coarser and rougher oblique streaks and bands; with two strong pale streaks at middle of inner margin, fusing into a vague patch, as a rule; but when distinct, with the outer one decidedly shorter than the more basal. *Speculum pale*, a mixture of white and dull silver, with some black scales. Apex black, preceded by two strong white striæ on costa. Fringe with a broad gray line, breaking up toward anal angle, and cut with white below apex. *Hind wing white*, shaded with fuscous outwardly and on veins, with pale fringe. 15 mm. (Thiodia).

May.

New Jersey to Pennsylvania.

4. **G. dulciana** Heinrich. Similar to *G. watchungana*, with the same contrasting pale speculum; ground more ferruginous brown, especially on the outer half of wing. Hind wing dark smoky. 14 mm.

June and July.

New Jersey and Maryland.

5. **G. deludana** Clemens. Tufts more distinct than in the preceding species, much weaker than in *G. bolliana*, the outer part of Cu_2 with a tuft like the others. Similar to *G. bolliana*, but with the ground more crisply powdered with white, and the brown areas small and crisply dusted with the yellowish scale-tips; blackish shades not obvious, but black lines strong; antemedial evenly concave up to the cell and then abruptly ending; the dorsal half of the base, when darkened, with an even straight upper boundary, not extended by an antemedial spur; black bar in end of cell not as strong as the one just beyond it, connected with the "bird-beak" marking; lower line of the "bird-beak" marking usually fine, and curved parallel to the antemedial line, and reaching down to the anal vein. Hind wing paler than that of *bolliana*, whitish at base. 15 mm.

May. Found in similar places to *G. amatana* and the Catastegas.

New Hampshire, to Plummer's Island, Maryland. New York: Crosby (Yates County).

6. **G. bolliana** Slingerland. R_4 and R_5 stalked halfway to apex; tufts at and along base of Cu_2, a second obliquely in and below this one on fold and anal vein, and on inner edge of speculum. Fore wing powdery gray, suffused with black on basal third below fold, as far as the first tuft, sometimes sending a spur up across the cell near the base; a black area in outer part of cell, bounded above by a black bar along upper edge of cell, and a blackish crescent, convex up, covering the bird-beak marking, and connected by a narrow black bar to the apex of the fringe. Upper part of face blackish, overhung by a large gray tuft between antennæ; lower face gray. 18 mm.

Caterpillar injurious to pecan in the South; moth flying northward in September and southward in April.

New Jersey to Wisconsin, Florida, and Texas. "New York" (Kearfott).

23. *EXENTERA* Grote

(With *Thiodia*, in part)

Similar to Gretchina; fore wings smooth (figs. 256, 261).

Cucullus normal; anal indentation with short black spines; no strong lateral spines; anal spines weak. Socii as in Hulda.

The genus is close to both Gretchina and Thiodia, and the species which have R_4 and R_5 separate differ from Thiodia only in their genitalia and appearance. They are narrow-winged forms that mostly fly in the early spring (whence the name of the type species). While the genus is easily recognized, after a little practice, the species are very close and not all are surely distinct.

1. **E. maracana** Kearfott. Notch well-marked. Fore wing whitish gray; dark basal patch extending a quarter of the length of the wing on costa and inner margin, and running out in a right angle at middle; a blackish shade extending out from middle of base; an oblique dark fascia from middle of costa to inner margin at anal angle, with a brown shade crossing it in the middle. Median area also shaded with light brown. A large horizontal triangular dark spot below costa, its base resting on costa and apex on outer margin; speculum with or without a few black dots; costo-apical white spots conspicuous; fringe blackish outwardly. Hind wing light smoky brown. 13–16½ mm.

End of March to April.

Cincinnati, Ohio; western Pennsylvania. New York: Ithaca, McLean.

2. **E. improbana** Walker. R_4 and R_5 normally barely stalked. Fore wing normally nearly immaculate gray, often with a strong purplish or greenish iridescence, or duller fuscous gray without contrasts; the antemedial line marked as the boundary of the darker base, more oblique on the dorsal half than in *E. spoliana*, and usually straight or evenly and gently curved. 18–20 mm. (*cressoniana* Clemens, *apriliana* Grote).

The moth flies in early spring and is sometimes very common. The various forms seem more or less constant locally, and would represent distinct strains. Larva on hickory and perhaps apple (another species?).

Eastern States: exact distribution uncertain on account of confusion with the following species; the race **oregonana** extending west to the Pacific.

3. **E. spoliana** Clemens. Typically gray, with strong whitish contrasts; a blackish area before antemedial line, and one on inner margin before anal angle; the antemedial line on dorsal half of wing normally strongly excurved or waved, and more erect in general course. The commoner form with strong reddish shades, at least over costal half of wing. Genitalia distinct from those of *E. improbana*. 18 mm. (*haracana* Busck, not Kearfott).

Caterpillar on chestnut, rolling the tip of the leaf. Moth in early spring, locally very common.

Northeastern States: exact distribution uncertain.

4. **E. haracana** Kearfott. R_4 and R_5 not stalked. Head and thorax blackish. Fore wing blackish with obscure coarse violet-gray striæ; becoming finer paired whitish ones at costa. An irregular black line from outer part of cell to apex, evanescent under high magnification. Speculum composed of two long lead-gray bars, the outer one broken; filled with clay-colored powdering, which also covers the region above it, below the dash. Three or four black bars in speculum. Fringe with faint longitudinal lines; the dash in the apex obscure. Hind wing rather pale. 15 mm. (*faracana* Kearfott?)

I have seen no decent material of this species; some specimens determined as *faracana* appear to show the longitudinal black streak in the axis of the wing.

New Jersey; Pennsylvania; Missouri?

5. **E. costomaculana** Clemens. Fore wing light pinkish ochreous or cream color, paler about the edge of the dark patch; a few scattered black scales. A large rounded brown patch, extending down from middle of costa, sharply defined below, but somewhat diffuse above and shading into the pale ground. Patch shaded with black. Fringe grayer than ground, dark at apex. 16 mm.

This species and the next differ from the similarly marked Epinotias in the pale base of the fore wing.

Common and general in distribution, April and May.

New York: Gowanda, Rock City (Cattaraugus County), Portage, Crosby (Yates County), Ithaca.

6. **E. virginiana** Clemens. Closely similar to *E. costomaculana* but averaging a little larger; ground light violet-gray, shaded with brown, especially below apex; not paler than hind wing. Patch rather darker brown than in *E. costomaculana*. Speculum indicated by well-marked black dots in the brown outer shade. 18 mm.

April and May.

Pennsylvania. New York: Ithaca, Pearl River, Albany.

24. *GYPSONOMA* Meyrick

(*Epinotia, Hedya,* in part)

Fore wing with apex rather marked, but not distinctly falcate, usually marked by an ocellate apical spot; outer margin concave, but more broadly than in the preceding genera; in *H. haimbachiana*, suggesting Anchylopera; M_1 to M_3 slightly approximate at margin; R_1 arising from cell at middle; R_2 halfway between R_1 and R_3; accessory cell short, commencing before the point of separation of R_2; Cu_2 straight; no costal fold. Hind wing with R and M_1 stalked. (Fig. 274).

Valve club-shaped; cucullus moderate; clasper rudimentary; anal indentation smooth; sacculus sparsely hairy. Uncus wanting; socii as in Charlotta, articulated on a stem, the gnathos partly fused with them.

1. **G. fasciolana** Clemens. White, shaded with gray toward outer margin; a few black scales in position of speculum. Outer part of costa dark gray, crossed by paired white striæ. Base blackish, the outer boundary oblique outward and a little convex; a broad fascia of the same color from middle of costa to before anal angle. 15 mm. This is very similar in markings to some species of Exartema and Olethreutes, but may be distinguished by the stalked M_3 and Cu_1 of the hind wing as well as by the lack of the fold on the inner margin in the male. There is a good deal of variation in the details of markings and the species should probably be divided. This species and the next represent Meyrick's genus Gypsonoma, but there do not seem to be any really tangible characters. (*Epinotia* auct., *Anchylopera* Clemens; *blakeana* Grote.)

July.

A northern species, ranging from Nova Scotia to Manitoba, and south to Pennsylvania. New York: Peru, McLean, Karner, and New Windsor.

2. **G. substitutionis** Heinrich. Blackish. Head grayish fuscous; fore wing with moderately broad white median area, its inner margin regularly excurved and outer margin outwardly oblique and a little irregular; outer part of costa with four pairs of white striæ; the first and third pairs lying at the commencement of irregular excurved lead-colored bands, which approach and become broader toward inner margin, forming the speculum. Speculum enclosing a few black dots or bars. Fringe dark, with a blackish basal line. Hind wing dark. 12 mm.

July.

Manitoba; New York: Ithaca.

This is the American representative of *G. incarnana*, and may stand as it in some collections, but as a rule that name has been used for specimens of the ***transmissana*** group of Epiblema.

3. **H. haimbachiana** Kearfott. Dull gray, less brownish than *H. salicicolana*. Basal third blackish and strongly contrasting toward inner margin, becoming lighter toward costa, its outer boundary angled at **Cu**, often forming nearly a right angle. Often with a slight gray shade, but little darker than the general color, from middle of costa to inner margin, three-fourths way out, bent somewhat at middle, and somewhat irregular, twice as wide at inner margin as at costa; also with some vague striation. Apical dot black, contrasting, but a little blurred; line in fringe distinct toward costa. Concavity on outer margin a little shallower and broader than in *H. salicicolana*. 15 mm. (*Epinotia*? Kearfott).

June to August. Superficially *H. haimbachiana* is rather like *Rhopobota ilicifoliana*, but it is easily distinguished by the shallower notch in the margin as well as by the free R_4 and R_5, and the lack of sex-scaling.

New Jersey to Wisconsin and southern Ohio.

4. **H. salicicolana** Clemens. Notch well marked and well above middle of wing. Dull gray-brown, when fresh with a slight purple gloss; the basal third contrastingly darker, obscurely mottled, the outer two-thirds sometimes frosted with whitish; outer boundary of dark base strongly outcurved at middle. A dark streak from costa beyond middle to middle of wing at two-thirds way to apex, sharply bent there, and very obscurely continued to inner margin. Dark apical dot obscure, preceded by a pale stria; dark line in fringe obscure below, distinct toward costa. 12 mm. (*Epinotia, Hedya; saliciana* Clemens).

June. Larva a leaf roller on willow; also in "pine-cone" gall.

New Hampshire to Pennsylvania, and probably generally distributed. New York: Ithaca.

25. *ZEIRAPHERA* Treitschke

(*Epinotia*, in part)

Thorax and fore wing smooth. Fore wing (fig. 253) with outer margin evenly excurved, the veins not at all approximate at margin. R_4 and R_5 sometimes connate, not stalked; Cu_2 slightly bent up toward margin; no costal fold.

Valve sickle-shaped; anal indentation densely spined; cucullus large; sacculus reduced, not strongly spined, but practically always with a series of bristles homologous with the enlarged ones of Proteoteras, but far less conspicuous. Uncus rudimentary; socii broad, triangular; gnathos free, weak.

This is a homogeneous genus, and perhaps more primitive than its position would appear to indicate, as it closely resembles the species of Epinotia which have a similar wing form. *P. claypoleana* is put in this genus by Heinrich, but differs markedly in wing form, and I would put more weight on the characteristic larva than on the small difference in genitalia.

Key to the species

1. Costal half brown, contrasting with the pale dorsal half; the boundary on middle of wing sharply defined, forming a rounded lobe.
2. Base of inner margin below fold contrasting pale gray, sharply separated from the black-brown costal portion.....4. *Epinotia lindana.*
2. Base of inner margin concolorous, or gradually shading into the light red-brown costal portion.....3. *Epinotia septemberana.*
1. Costal half not contrastingly dark.
2. No silvery fasciæ.
3. Whitish gray with oblique darker pattern.....23. *Thiodia tarandana.*
3. Ground not whitish.
4. With broad areas of yellow-brown.....3. *ratzeburgiana.*
4. At most, dusted with yellow-brown.
5. Expanse 10 mm.; blackish with dirty white striation. 1. *Epinotia nanana.*
5. Expanse 15 mm.; base of fringe cut with white.
6. Blackish with ash-gray striation.....1. *diniana.*
6. With white fasciæ and striations.....2. *fortunana.*
3. Conspicuous bright silver fasciæ.....2. *Epinotia cruciana.*

1. **Z. diniana** Guenée. Ash gray, powdery-strigose in two shades; fore wing with antemedial line right-angled in middle of wing, defining the darker base; a fascia from costa, just beyond middle, to anal angle; a little irregular, and widening slightly to inner margin; clearly defined below, but sometimes connected at costa to the dark base and outer margin by blackish suffusion. Outer margin dark shaded, with this shade not forming a definite fascia. Fringe cut with white twice below apex, and twice at anal angle. Hind wing somewhat browner. 18 mm. (*pinicolana* Zeller, *pseudotsugana* Kearfott).

August. Larva green-gray, with black head, dark brown cervical shield, and dark tubercles, between needles spun together of various conifers; fir, larch, and others. Pupa in the ground.

Arctic-alpine; Mt. Washington, New Hampshire, and north. "New York" (Fernald).

2. **Z. fortunana** Kearfott. Black-brown, sometimes dusted with wood-brown; with a broken double white fascia at base; an irregular but strong and complete excurved fascia just before middle; irregular white markings outwardly, the most distinct usually a fascia starting from costa at three-fourths way to apex and running two-thirds way across to anal angle, with a patch on outer margin at its lower end. A few additional white striæ at costa. Black basal line in fringe cut with white at fold and anal agle. Hind wing mouse gray. 15 mm.

End of June to July.

Ottawa, Ontario.

3. **Z. ratzeburgiana** Saxesen (in Ratzeburg). Yellow-brown, or light wood-brown; antemedian band dark brown, and defining a darker base, sharply angled at lower side of cell, and bent in, in cell; outwardly, with a fascia from middle of costa to anal angle, wider above; normally broken into three toward costa, and sometimes crossed by a black bar along lower side of cell. With a shade of mixed black and dark brown, extending obliquely down from apex, often preceded by a white snade and followed on middle of outer margin by a white stria. A dark brown line in fringe. This moth is variable in details of markings. 12 mm.

Larva webbing together the terminal needles of spruce in early spring. Pupation outside the nest. Moth in July and August.

Ottawa, Ontario, to Washington, and probably general where its food plant occurs; also in Europe.

26. *PSEUDOGALLERIA* Ragonot

Palpi porrect, clavate; the tip formed by the third joint but markedly set off only in rubbed specimens. Thorax tufted. No sexual modifications. Fore wing with all veins separate, and evenly spaced at margin; wing rather long and narrow, as in Thiodia; apex marked; outer margin with a strong concavity centering on M_1 and M_2; R_2 arising from discal cell. Hind wing normal, with R and M_1 approximate, M_2 close to M_3 at origin, M_3 connate or shortly stalked with Cu_1. Eighth segment of abdomen somewhat chitinized and modified. Valve simple. Uncus and socii absent. Gnathos weak.

An isolated genus. The wing form and the modification of the eighth segment suggest Hystrichophora, but in the remaining genitalic structures there is no likeness.

1. **P. inimicella** Zeller. Dull gray, more or less shaded with brown; the notch in the margin edged with a brown band. Costa heavily shaded with blackish. Hind wing practically concolorous. 13–20 mm.

June. Apparently rare. Larva boring in rootstocks of Smilax.

New Jersey to Manitoba and Texas. New York: Ithaca.

27. *HYSTRICHOPHORA* Walsingham

Fore wing similar to Pseudogalleria; Accessory cell normal.

Male genitalia with eighth segment of abdomen modified. Valves asymmetrical; a strong dorsal process arising from the upper articulation of the valve and extending out parallel to it; cucullus and sacculus not defined. Uncus long strong, triangular, bifid; socii and gnathos absent.

Three species of this genus are likely to occur in the territory considered. *H. vestaliana* Zeller is white with black points, and is known from Iowa; *H. ochreicostana* Walsingham is brown and yellow, and has been taken in Missouri and west; *H. kokana* Kearfott, a smoky species with contrasting pale border, occurs to the southward.

28. *EPISIMUS* Walsingham

(*Enarmonia* Walsingham and Durrant, in part)

Similar to Thiodia, but with M_3 and Cu_1 of hind wing connate (fig. 262) instead of stalked. Fore wing smooth, with all veins free.

A transitional genus, connecting the Eucosmini and Olethreutini.

1. **E. argutanus** Clemens. Costa thickened, but not folded, in male. Dull reddish or grayish brown, the color made up of fine mottling in wood-brown, gray-brown, and blackish, overlaid when fresh with purple. Costa shaded with blackish along middle; speculum confused, dark gray toward base of wing, paler outwardly, and more brown in the upper part, where there are a couple of black dots. 13 mm. (*Bactra* Clemens).

May. Larva on various shrubs, especially Rhus and Hamamelis; on Euphorbia in the south. The larva lives between two leaves sewed together, or rolls a leaf into a cone. (Possibly *Catastega hamameliella* Clemens).

New York to Florida. New York: Speculator, Crosby (Yates County), Ithaca, New York City.

2. **E. tyrius** Heinrich. Whitish gray, tinted with ochre, and shading into orange ochre and reddish toward outer margin. Costal part on basal half dark brown, contrasting, the boundary sharp toward base, and strongly curving down in antemedial region, diffuse outward. Hind wing dark gray. 12–15 mm.

Larva on maple, with nearly the habits of *E. argutanus*.

Long Island, New York to Mississippi.

29. *OLETHREUTES* Hübner

(*Argyroploce; Penthina; Sericoris; Eucosma,* in part, etc.)

Palpi porrect (fig. 281), clavate or triangular, with short porrect third joint. Thorax tufted behind; fore wing smooth or with slight tufts or ridges at end of cell and near base of inner margin. Fore wing (fig. 266) with all veins free and well spaced at the margin, which is evenly rounded, M_2 a little spaced from M_3 and Cu_1 at origin; no costal fold. Hind wing with R and M_1 approximate or stalked; M_2 distinctly separate from M_3, but rarely as widely as in Laspeyresia (*O. hebesana*); M_3 and Cu_1 connate, rarely stalked, or very slightly separate. Inner margin in male thickened and variously folded or rolled up; sometimes with a lobe as in Exartema, but if so, with the lobe concealed in the fold, and quite small; usually with a hair pencil. No thickening or dense scaling except on dorsal margin. Hind tibia of male with a hair pencil arising from base (rather fragile, and lost in rubbed specimens) but without long dense hair. Rarely, the dorsal fold or tibial hair pencil are rudimentary, but never both in the same species.

This is a large and well-defined genus (at least in the male) from which Phæcasiophora is derived; it is closely related also to Cymolomia and, to judge by the occasional occurrence of a free lobe on the inner margin, is perhaps derived from it; more probably it is heterogeneous, composed partly of older and partly of newer species than Cymolomia. Bactra is also considered related, but lacks the thoracic tuft. The male is easily distinguished; the female is like that of Cymolomia and Phæcasiophora, but can be distinguished from other genera by the combination of tufted thorax, practically smooth wings, approximate R and M_1, and M_2 shortly but distinctly separate from M_3 and Cu_1. Ecdytolopha and Gymnandrosoma have nearly the same combination of characters, and are united to it by Walsingham and Durrant, but M_2 is more widely separated, the palpi are smooth, and the general appearance is different.

Key to the species

1. Fore wing dark, with moderate, clearly-defined white costal patch.
   2. Patch a third the length of the wing, its edge sharply defined and even. ..... 33. *chionosema.*
   2. Patch less than a quarter length of wing, irregular or diffuse on the lower outer side.
      3. Patch pink ..... 31. *roseomaculana.*
      3. Patch white ..... 32. *costimaculana*
1. Fore wing whitish with dark shade toward middle of costa ..... 30. *albeolana.*
1. Median area evenly yellow, contrasting.
   2. Outer part of wing almost evenly purple-black ..... 39. *ochromediana.*
   2. Outer part of wing with darker, pale-defined patches ("Cymolomia pattern") ..... 38. *osmundana.*
1. Median area with a large, evenly colored patch of greenish or olive-gray.
   2. Patch on inner margin, between two black patches.
      3. Base and middle of costa pale ..... 35. *griseoalbana.*
      3. Base and middle of costa blackish ..... 34. *impudens.*
   2. Patch not resting on inner margin; outer part of wing deep rose. ..... 36. *malachitana.*
1. Ground yellow and yellow-brown or yellow-brown and black-brown, separated by brilliant blue metallic lines or series of dots.
   2. Ground two shades of dark brown; small (12 mm.) ..... 19. *coronana.*
   2. Paler portion of ground ochre yellow; large (18 mm.)

3. Hind wing beneath dark, concolorous with fore wing.....16. *coruscana.*
3. Hind wing beneath contrastingly pale, somewhat darkened at costa only.
4. Hind wing below all pale; wings rounded.....18. *astrologana.*
4. Costa of hind wing below darkened; hind wing more or less quadrate, with the outer margin at an angle to the dorsal and outer margin of fore wing nearly straight.....17. *constellatana.*

1. Fore wing with base dark gray, contrasting with the whitish apical third or half.
2. Outer boundary of gray area, located near middle of wing, diffuse and farther out on costa than on inner margin..... (*Ecdytolopha islandana.*)
2. Outer boundary clean-cut, more transverse, and farther out.
3. Smaller, ground of apical part pinkish; outer boundary of dark base usually striking inner margin well before anal angle; often followed by a separate blackish stria.....27. *separatana.*
3. Larger; ground pure or cream white; outer boundary running almost to anal angle, the stria being sometimes traceable, but fused in with the blackish base.
4. Apical white ground extended as a hook in apex of cell, partly outlining a black dot in lower angle of cell.
5. Expanse over 18 mm.....23. *capreana.*
5. Expanse 15 mm.; apical white region less sharply defined. 22. *apateticana.*
4. No white hook in end of cell, and usually no obvious black dot in lower angle.
5. Outer boundary of black area distinctly excurved at middle; subapical gray streak small.....25. *nimbatana.*
5. Outer boundary of blackish area nearly straight and erect, the apical markings dusted with black, instead of being smoothly gray.
6. Dorsal half of pale apex suffused with gray.....26. *tertiana.*
6. Apical region almost wholly clay-color.....28. *montanana.*
5. Outer boundary of blackish area drawn in at cell, with a well-marked notch, surrounded with black.
6. Eyes reduced .....21. *frigidana.*
6. Eyes large; a large mottled species.....24. *youngana.*

1. Fore wing with ante- and postmedial costal spots on a blackish ground; eyes small .....6. *mengelana.*

1. Fore wing with a clear white antemedial fascia, sometimes lightly scaled with gray, or with whole middle costal area suffused with white, and the fascia distinct only toward inner margin; eyes large.
2. Blackish median fascia only narrowly reaching costa, or falling short; very broad at inner margin.....29. *duplex.*
2. Median fascia broad at middle, tapering strongly to costa and inner margin. 15. *aspasiana.*
2. Blackish median fascia of nearly even width, and on costa about a fourth as wide as length of wing.
3. Apical portion of tegulæ and bands on disc of thorax white..3. *carolana.*
3. Thorax and tegulæ blackish.
4. Postmedial fascia forking, and enclosing a triangular blackish dorsal spot (the inner fork gray, only the outer one white) dark markings overlaid with slender yellow scales.....5. *campestrana.*
4. Median area solid blackish; no triangular patch cut off on its outer side.
5. Fore wing broader, the blackish median fascia normally nearly twice as high as wide, median area with large lead-gray flecks. 1. *bipartitana.*

5. Fore wing narrower, the median fascia almost as wide as high median area not flecked with lead-gray.
6. White discal dot obvious, connected with postmedial line and flanked above and below with black teeth, as in Cymolomia. 4. *polluxana*
6. White discal dot obsolescent, not connected with postmedial white the postmedial line nearly straight opposite cell. 2. *fuscalbana*, 3. *carolana*

1. With antemedial fascia yellowish, gray-filled, or dull lead-gray; less contrasting, on a dark brown ground; sometimes reduced to costal and dorsal groups of striæ.
2. Fascia yellowish, not shining.
3. Median dark area about of equal width throughout.....14. *instrutana*
3. Median dark area half as wide at costa and inner margin as at middle 15. *aspasiana*
2. Fascia lead-gray, or replaced by shining striæ.
3. Expanse 16 mm. Fascia, when complete, of three or four partly fused striæ.
4. Ground mostly dark brown.
5. Brown terminal dots in base of fringe.....9. *septentrionana*
5. No such marking.....8. *intermistana*
4. Ground overlaid with tawny yellow.....10. *schulziana*
3. Expanse 10 mm. Fascia of two striæ.....11. *abietana*
2. Fascia luteous, but outlined with faint silver.....20. *major*
1. Ground even rich dark brown, with narrow darker median fascia.
2. Fascia obscure, Cu_2 normal.....49. *infuscata*
2. Fascia clean-cut, Cu_2 arising three-fourths way out on cell....41. *hemidesma*

1. With "Cymolomia pattern."[33]
2. Small; ground whitish or suffused with dull gray.....34. *impudens*
2. Ground rusty orange, marked with dull red; discal dot white. (*Phœcasiophora niveiguttana.*)
2. Dull rose, shading into luteous; a black longitudinal dash in outer part of wing .....37. *interruptolineana*
2. Dark wood-brown, the subterminal and lower end of the median patch markedly triangular .....48. *nubilana*

1. Markings dark, dull, and confused, without a clean-cut subterminal patch of lead-gray marks, if present, not gathering into antemedial fascia; no white or pale colors.
2. Fore wing all of dull colors (or with some slightly shining scales irregularly distributed).
3. Clear powdery ash-gray; scales bicolored.
4. Individual scales gray and fine white tips.....13. *removana*
4. Individual scales black with white bars.....12. *deceptana*
3. Not clear powdery gray; the powdering, if present, yellow; individual scales unicolored.
4. Lighter markings composed of paired lead-gray striæ and yellow scaling; larger forms.
5. Fringe with brown dots in its base.....9. *septentrionana*
5. No brown dots in base of fringe.....8. *intermistana*
4. Fore wing with metallic scaling, if present, in broad areas; no yellow scaling.

[33] Ground of a lighter shade, usually brown; the markings mostly clean-cut, finely pale outlined, outwardly consisting of a strongly irregular median fascia, sometimes interrupted; an oblique subterminal spot resting on the middle of the outer margin, and a subtriangular spot at the anal angle, all rather evenly colored in a darker shade; the subterminal patch alone of these really distinct in *interruptolineana*.

5. Ground purple-black, not darker at middle of costa....43. *dœckeana.*
5. Ground brownish, with a blackish shade at middle of costa.
42. *hebesana.*
5. Lighter dull fuscous with a vague transverse luteous band.
40. *murina.*
2. Fore wing with some brilliant blue iridescence.
3. With a well-defined, vertical, blue-gray bar before anal angle.
4. Sparsely dusted with ochre.
5. Head light ochre.....46. *auricapitana.*
5. Head fuscous; only palpi paler.
6. Fringe almost entirely dark.....45. *agilana.*
6. Fringe on costal half of outer margin mostly cream-white.
47. *albiciliana.*
4. Heavily dusted with cream and whitish.....7. *turfosana.*
3. With a large blue patch before anal angle, ground blackish..44. *cyanana.*

O. conditana is probably confined to California: eastern records are based on dwarfs of *hebesana*, and specimens of Polychrosis.

1. **O. bipartitana** Clemens. Fore tibia with faint pale bands; mid-tibia usually all black, and hind tibia whitish. Palpus with more fuscous than in *O. fuscalbana.* Fore wing rather less than twice as long as wide; mixed dark shining blue-gray and black; a white antemedial fascia, with some black scales, a sixth as wide as length of wing, erect and of even width, its boundaries slightly irregular. Beyond this a blackish fascia, slightly broadening toward inner margin, reaching out to end of cell. The rest of wing white, shaded with gray on the apical half, more or less, or with a separate gray margin and subterminal patch. Costal edge gray, with paired white striæ. Hind wing typically whitish, gray in variety *cæsialbana* Zeller; fringe whitish. 16 mm. (*Antithesia* Clemens).

May and June; August.

Common everywhere. New York: North Elba, Fentons (Lewis County), Oswego, Jamestown, Rock City (Cattaraugus County), Millerville, Otto, McLean, Ithaca, Big Indian Valley, Albany, Ramapo.

2. **O. fuscalbana** Zeller. Fore tibia with three heavy white bands; mid-tibia with two or three weaker ones; palpus heavily mottled with white. Wings slightly narrower than *O. bipartitana;* antemedial fascia somewhat narrower, hardly more than half as wide as the blackish area following it, which is more or less dusted with broad yellow scales. Apical region more distinctly blackish, especially the apical dot; subterminal bar conspicuously dark. 15 mm.

June to August; common.

Generally distributed, south to North Carolina. New York: Peru, North Twin Brook (Mt. Marcy), Newcomb, Peru, Rock City (Cattaraugus County), Ithaca, Trenton Falls, Fort Edward.

Gypsonoma fasciolana is near this species in appearance, but differs in the stalking of M_3 and Cu_1, the wing-form, and the narrower, decidedly oblique median dark fascia, preceded by a broader and purer white antemedial fascia. *Cymolomia fasciatana* has similar tibiæ, but the palpi are almost wholly whitish; and the antemedial fascia is considerably stronger than the postmedian.

3. **O. carolana** McDunnough. Tegulæ white, with a dark patch at the base; thorax banded with white. Blackish and olivaceous brown; antemedial white band slightly irregular; subterminal white band narrow, the terminal area being broadly suffused with olivaceous brown; anal spot fused in with the dark median area, with a point of the white color running between them above; two olive-brown costal spots, sometimes connected by hair-lines with the brown terminal area. 14 mm. (Not seen.)

June.

Ottawa and Trenton, Ontario.

4. **O. polluxana** McDunnough. Similar to *O. fuscalbana.* Ground blackish, without any yellow overscaling. Antemedial fascia about as in *O. fuscalbana;* postmedial more irregular, and broken into by patches of the black ground; the blackish medial area extending in two strong teeth at the end of the cell with a white indentation between them. Outer markings almost entirely brown-black and white, without the gray subterminal band of *O. fuscalbana.* 25 mm.

June and July.

New York to Alberta. New York: North Twin Brook (Mt. Marcy), Peru.

5. **O. campestrana** Zeller. Similar to *O. fuscalbana.* Ground overlaid with slender yellow scales. Antemedial band more distinctly made up of two pairs of fused white striæ. Postmedial white band on costal half formed of two pairs of white striæ; below the middle the anterior pair becoming gray and turning abruptly in to the middle of the inner margin, while the outer pair becomes a broad white band extending to the anal angle; the two enclosing a triangular blackish patch between them. Outer part of wing blackish, with strong paired white costal striæ, and a couple of longer white striæ, defining the usual subterminal patch. A white subterminal line toward apex. 15 mm. (*dealbana* Walshingham, not Walker).

June. Larva on cherry.

Generally distributed and not rare, but generally confused with *O. fuscalbana.* New York: Peru, Rock City, Ithaca, Trenton Falls, Albany (New York State Museum).

6. **O. mengelana** Fernald. Eyes very small. Ground powdery black on a blue-gray base; antemedial whitish fascia distinctly composed of a group of three or four coarse striæ, fading out below; postmedial white fascia broad and distinct toward costa, of two pairs of striæ, becoming obscure below the middle of the wing. Outer margin with the blue-gray dominant. Outer half of fringe cut with white. 15 mm.

July.

Greenland. This is probably a widespread arctic species, but I have seen no other specimens.

7. **O. turfosana** Herrich-Schæffer. Fore wing with nearly even, broken, transverse striation of blackish, clay color and lead gray, but with the pale striæ more or less paired, especially at the costal edge. Outer part of wing normally more heavily shaded with the yellow. A white spot at end of cell, partly defined with blackish. Fringe blackish, irregularly cut with white. Hind wing dark gray. 16 mm.

June and July.

Labrador; Maine; Europe.

8. **O. intermistana** Clemens. Blackish gray with a variable amount of yellow and white scaling. Fore wing with confused paired white or light blue-gray double striæ, cutting up the ground into patches toward the outer margin, but leaving fairly definite narrow antemedial blackish bands, or with the striæ toward base confined to costal and dorsal edges. Scaling sometimes gathering to form a pale shade at anal angle. A white discal dot. Fringe black and white. 18 mm. (*tessellana* Packard).

August.

Labrador to Alberta; Mt. Washington, New Hampshire.

9. **O. septentrionana** Curtis. Blackish brown, somewhat variegated with gray, leaving a darker oblique fascia as in *O. intermistana;* costa with six or seven pairs of white striæ; fringe pale, spotted with brown at the base. Hind wings apparently variable. 15 mm. (*Sciaphila primariana* Walker; *Penthina fulvifrontana* Packard).

Arctic America south to Labrador.

10. **O. schulziana** Fabricius. Fore wing black, heavily overlaid with narrow bright yellow scales, with somewhat confused and broken paired white striæ, the

ubterminal ones not anastomosing as in *O. intermistana*, but leaving a clear ostmedial band of the ground. A white spot at end of cell, partly edged with lackish. Fringe checkered black and white. 18 mm.

The larva is said to feed on pine or Vaccinium.

Europe; also reported from Arctic America.

11. **O. abietana** Fernald. Fuscous brown, marked with shining gray. A slight ray basal facia; a broad antemedial fascia, starting from two pairs of costal triæ. A postmedial fascia, also starting from two pairs of striæ, with a small ark dot between them, its outer side somewhat wavy and its inner side with two eep notches (above and below the cell), into which run teeth from the brown nedian area. (Two pairs of costal striæ toward the apex, from which runs a broken rregular subterminal fascia. Hind wing dark. 10 mm. (*piceæ* Busck).

Larva on spruce.

Maine to the Western States; generally distributed northward. New York: thaca, Woodmere, Long Island.

12. **O. deceptana** Kearfott. Finely dusted with white, gray, and black, the ray scales white-tipped; no yellow or other colors. Head and thorax concolorous. Fore wing with costa arched, transversely strigose; base slightly darker, with excurved irregular outer boundary; median fascia bluntly two-toothed, barely raceable; the notch between the teeth white-filled, but not forming the definite pot of the *intermistana*-group. A slight narrow fascia across apex. Hind wing uller; brownish gray. 18 mm.

June to July.

Peru, New York; Dickinson, Michigan, and westward.

13. **O. removana** Kearfott. Ash gray; each scale finely pale-tipped as seen under a lens; superficially similar to *O. deceptana*, but actual ground color much paler, with faint transverse bands; an oblique band at a fourth way out and one at middle of costa, and a distincter subterminal bar, sometimes defined with distinct black striæ. Hind wing a little browner. 17–21 mm.

When most distinct, the darker gray shows the Exartema pattern, with subterminal and anal patches, and with median band rather narrow and deeply dentate on the outer side, but all in shades of ash gray.

New Jersey to Manitoba.

14. **O. instrutana** Clemens. Dark brown mixed with blackish, heavily overscaled with rusty ochre; antemedial fascia of a group of broken luteous striæ; postmedial band a double, lead-gray stria, strongly and broadly curved out over middle of wing, and a little concave toward inner margin. Discal dot pale, well within the postmedial bands. Three pairs of white striæ on costa outwardly; an oblique lead-gray line across apex and a confused patch at anal angle. Hind wing dark. 15 mm.

Common and generally distributed. Larva reported on clover and buckeye. Much like species of Cymolomia, but distinguished by the browner color with yellowish antemedial line and discal dot, and continuous gray postmedial band. Moth in August.

New York: Peru, Saranac Inn, Newport, Fentons (Lewis County), Batavia, Otto, Ithaca, Schenectady, Rhinebeck, New Windsor.

15. **O. aspasiana** McDunnough. Similar to *O. instrutana*. Dark olivaceous brown, with a double whitish antemedial fascia, and some whitish scaling at base. Medial dark area twice as wide at middle as at costa and inner margin, its outer boundary strongly bowed out at the middle, and scaled there with black. Subapical band extending from costa to outer margin, and containing a leaden-colored patch opposite the cell; anal spot long, narrow, triangular, brown. Apex also brown, cut off by a silvery streak. 11 mm. (Not seen.)

Early July.

Ottawa, Ontario.

16. **O. coruscana** Clemens. Fore wing ochre yellow, marked with bands and

patches of brown (formed of blackish dusting on an ochre ground), the markings edged with series of silver-blue raised dots, which form continuous lines on the outer part of the wing. Basal markings confused; median band broad, not quite reaching the inner margin, which is yellow with a few black scales; the band deeply notched on its inner side, at the cell; and opposite cell and on Cu, on the outer side; a good-sized spot at anal angle; a larger band across apex, and a small apical spot. Fringe mixed, yellow, brown, and gray, quite variable. Hind wing fuscous brown; fringe white with a brown line in base; below dark fuscous, concolorous with fore wing. 16 mm. (*argyroëlana* Zeller).

June and July.

Common and generally distributed south to Pennsylvania. New York: Fentons (Lewis County), Newport, Rock City (Cattaraugus County), Portage, Big Indian Valley, Albany, Poughkeepsie, New Windsor, New York City; Lynbrook, Long Island.

17. **O. constellatana** Zeller. A little larger on the average than *O. coruscana*; the black mottling covering the whole surface except on the apical third, and even there somewhat encroaching on the yellow ground, but leaving at least the subterminal patch distinct. Hind wing a little paler on the average; whitish below, strongly contrasting with fore wing. 20 mm.

With *O. coruscana*; not quite so common. New York: Otto, Rock City, Portage, Ithaca, McLean, Trenton Falls, Big Indian Valley, Schenectady.

18. **O. astrologana** Zeller. Ochre, almost evenly strigose with blackish on the basal two-thirds, becoming pale ochreous with light dusting on the apical third. Blue dots on basal part of wing evenly scattered; on apical part arranged in three oblique series, which indicate the outer side of the median fascia, and the edges of the subterminal fascia of *coruscana*, but with these fasciæ no darker than the ground. Fringe largely ochreous. Hind wing a little lighter than that of *coruscana*. 16 mm.

Valve below with a rough tubercle in place of a ventral spine.

Illinois; Texas. New York: Mt Marcy, Newcomb.

O. albiciliana approaches this group in the scattered blue spotting, but is much darker without any areas of clear yellow, and the hind wing is contrastingly paler at the base.

19. **O. coronana** Kearfott. Closely similar to small specimens of *O. astrologana*; fore wing almost wholly suffused with black, leaving only some broken ochre fasciæ in postmedial and subterminal regions, especially toward costa. 12 mm.

June.

Canada; Trenton Falls, New York.

20. **O. major** Walsingham. Fuscous, similar in color and wing form to *O. constellatana*, but with the pale portions duller. Fore wing with a dull luteous, erect antemedial fascia, and a parallel postmedial fascia running from two-thirds of the way out on costa to anal, both evenly edged with slightly brassy or silvery continuous lines. Outer half of costa with four pairs of pale striæ, the first two connected with the postmedial fascia, the third free, and the fourth running down into a rather pale subterminal fascia, which runs out at the middle of the outer margin. Hind wing fuscous with pale fringe. 22 mm.

July.

Northern United States and Canada. New York: North Twin Brook (Mt. Marcy).

This species is easily recognized by the faint continuous silvery or pale golden borders to the pale fascia, visible only in a favorable light. Eastern specimens are much darker than the typical form from the west coast.

21. **O. frigidana** Packard. Basal two-thirds dark gray, with obscure and confluent blackish and fuscous striæ and some scattered brown scaling, the outer boundary oblique from costa at two-thirds way to apex, to just before anal angle,

unning in distinctly to end of cell, and excurved or irregular from there to inner argin. Outer third white, shaded with blue-gray, and with a few black scales. Hind wing light fuscous gray. 15–18 mm.

July.

Labrador and White Mountains, New Hampshire, to British Columbia.

The Labrador form has perceptibly smaller eyes than the Mt. Washington race, nd has also more solidly dark palpi and a more contrastingly pale apical third f the fore wing.

22. **O. apateticana** McDunnough. Fore wing with base brown, with scattered hite scales, making a more or less distinct dash through center of wing. Basal ide of white outer part not quite sharply defined, but with a white hook in end f cell outlining a black dot, as in *O. capreana* and *separatana*. Apex shaded with rown; a distinct black subapical bar. Anal spot partly cut off from dark base y whitish scaling. 15 mm. (*deceptana* McDunnough, not Kearfott). (Not seen).

June.

Meach Lake and Ottawa, Canada.

23. **O. capreana** Hübner. Similar to *O. frigidana*, but with basal part of fore ing mottled, rather than striate, the brown and black tending to gather in the ntemedial and medial region, and the intermediate portions typically shaded ith whitish, gathering in two squarish patches on basal half of costa and a ague shade in base of cell. Outer boundary of the blackish base rather less ndented at end of cell than *O. frigidana*, where the white forms a comma-like hook, nd regularly convex from there to inner margin. (*funerea* Meyrick).

Typical *capreana* is European, and appears always to have the pale costal reas.

Labrador to Duluth, Minnesota, and British Columbia.

24. **O. youngana** McDunnough. Similar to *O. capreana*, Costa of fore wing on basal half heavily shaded with white, leaving a squarish dark antemedial spot. White apical area strongly angled in at end of cell, and more or less defined with black, but not extending hooklike around a black dot. 19–20 mm.

July and early August.

Laurentians, Quebec, to New York. New York: Wilmington.

25. **O. nimbatana** Clemens. Base solidly dark, a mixture of bluish and brownish black; apical third white with three or four light gray striæ on costa and a stronger gray subterminal streak. Outer boundary of the dark base sometimes regularly excurved, sometimes with a tooth projecting upward at fold, running from a little beyond the middle of the costa to just before the anal angle; fringe pale; hind wing light gray, or whitish with light gray border. 16 mm. (**H 48**:24, as *Platynota flavedana*.)

June to August. Common. Larva on rose.

General, at least from New Jersey northward. New York: Ithaca, Albany, Rhinebeck, Scarsdale.

26. **O. tertiana** McDunnough. Base of fore wing purplish brown, dusted with bright brown, and mottled with darker; a few white antemedial scales. Boundary of pale outer half oblique and rather irregular. Outer part shaded with bright brown toward apex; with a dark subapical bar, the region between the inner margin and the subapical bar largely filled with a grayish shade. 16 mm. (Not seen.)

June.

Ottawa, Ontario.

27. **O. separatana** Kearfott. Fore wing with basal three-fifths, mixed gray and blackish; the outer boundary nearly straight from costa, rather before two-thirds, to inner margin, rather beyond two-thirds; followed by blackish spots at end of cell and on inner margin. Outer third pale pink, shaded with light gray. Basal half, except on base of inner margin and on middle of costa, also sometimes

shaded with pale pinkish gray. Hind wing fuscous gray. 13 mm. (*O. dimidiana* auct., not Sodofsky).

May, July, and August. Larva on rose and blackberry.

Hampton, New Hampshire, to Missouri and Arkansas. New York: Ithaca, Big Indian Valley.

28. **O. montanana** Kearfott. Similar to *O. nimbatana*, the outer boundary of the dark base erect, nearly straight, and somewhat diffuse. Pale portion duller and more clay colored.

Ithaca, New York; North Carolina.

29. **O. duplex** Walsingham. Base light gray, striate with blackish; the outer boundary oblique on costal two-thirds, sharply bent in on A and out again to the inner margin. Antemedial area white, a large mottled blackish patch resting on inner margin from middle almost to anal angle, more or less divided by irregular whitish marks, a more or less distinct gray or blackish fascia extending from the upper side of the patch obliquely to the middle of the costa. Outer part of wing white, the apical region shaded with gray and sometimes some brown, usually leaving the costa, except at extreme apex, and a band extending to anal angle, white; more rarely, with only the costa white, and the dorsal region strigose or suffused with gray or brown. Hind wing light gray. 18–27 mm.

June and July. Larva a leaf roller on poplar, forming a roll very much like that of *Anacampsis innocuella*.

New York to Pennsylvania, and west to California. New York: Peru, Ilion, Portage, Ithaca.

This species is intermediate between the *nimbatana* and *bipartitana* groups and is possibly nearer the latter, with which it is almost always confused in collections.

30. **O. albeolana** Zeller. White, marked with dark gray. An oblique bar on costa at a fourth way from base; a much larger rounded patch at middle of costa; a gray shade along inner margin to middle, defined by a black dash in base of fold, but outwardly diffuse or breaking up into striæ; a black dot at lower angle of cell, and some lighter gray shading on outer third of wing. Hind wing brownish gray. 18 mm. (*hartmanniana* auct., not Linnæus.)

June and July. Larva a leaf roller on white birch.

Maine to New Jersey. New York: Big Indian Valley, Karner, New Windsor.

31. **O. roseomaculana** Herrich-Schæffer. Fore wing deep blue-gray, mottled with black, with an irregular pink fascia of moderate breadth from third quarter of costal margin to outer margin at anal angle, sometimes broken into costal and anal patches by a gray shade. Hind wing mouse gray. 15 mm.

Larva on Pyrola.

Europe; Labrador.

32. **O. costimaculana** Fernald. Blackish, shaded with blue-gray and whitish. Base, and especially second fourth of costa, strongly dusted with whitish; a large square white patch on costa at two-thirds way out and some white striæ at anal angle. Hind wing gray. 11–14 mm.

Maine; Massachusetts; Manitoba.

33. **O. chionosema** Zeller. Blue-gray, somewhat shaded with duller gray. A large half-pear-shaped white patch from middle almost to apex of costa, with smooth clean-cut boundary; the dark part of the wing blackish around it. Hind wing dull gray. 15 mm.

Larva on thorn and apple.

New Brunswick, and Montreal, Quebec, to Virginia and Western Pennsylvania. New York: Ithaca, Schenectady, Albany.

34. **O. impudens** Walsingham. Typically cream-white, rarely dull gray; base blackish, with outer boundary angled on cell; costa usually diffusely shaded with blackish to beyond middle, obscuring the antemedial fascia, and toward the apex more narrowly dark, cut with paired white striæ. A broad, typically white, antemedial fascia, in gray specimens distinctly composed of about four striæ,

lowed by an irregular olivaceous patch on dorsal half of wing, beyond which ere is a blackish spot on end of cell, and one farther out on the dorsal margin; ddle of costa also with a dark patch, obscured by the blackish shading. Fringe rk; hind wing pale in the typical form, gray in the dark phase. 12 mm.
June and July.
New Hampshire to North Carolina and Manitoba. New York: Newcomb, Rock ty (Cattaraugus County), Batavia.

35. **O. griseoalbana** Walsingham. Whitish; costal edge dark gray, cut with ite toward apex; outer edge blackish, preceded by white striæ. Base dark ay, *except at costa;* a pale rounded gray patch at middle of dorsal margin, and smaller black one before hind angle, with some black striæ on the white ground tween them. Hind wing dark. 15 mm. (*Exartema*).
June to August.
New Hampshire and Massachusetts to southern Ohio.

36. **O. malachitana** Zeller. Dull crimson, a little powdery, thorax and base wings dull powdery gray. A large olive patch reaching from end of cell almost base of wing and down to below A, striate with whitish on costa, and defined on e whole lower side by an evenly curved whitish line. A horizontal brown crescent om end of cell to outer margin, concave downward, and a spot at beginning of rsal fringe. Fringes concolorous; hind wing mouse gray. 15 mm.
Larva on persimmon.
Virginia and Pennsylvania to Quincy, Illinois, and south.

37. **O. interruptolineana** Fernald. Wood-brown, shaded with dull rose and violet. asal half light grayish toward costa, ending abruptly at a square brown median stal patch, and edged below with a sharply defined dark brown bar extending om inner margin near base a third way to apex. An irregular brown patch tending from cell opposite the median costal spot to middle of outer margin, nstricted so as to appear composed of three partly fused patches, of which the st may fuse with the median costal spot, and the middle one may be hardly rker than the ground. Apex often brown, cut off by a pale stria. 13 mm.
May; July and August. Larva on Vaccinium.
New Hampshire to District of Columbia.

38. **O. osmundana** Fernald. Dull gray-brown. A large yellow-brown patch tending from middle of inner margin two-thirds way to costa; a dark brown tch, half as large, at anal angle; a subterminal bar and a short oblique bar om middle of costa, all fairly clean-cut and finely pale-edged. Hind wing mouse ay. 10 mm.
Larva on *Osmunda regalis;* also reported from seeds of Ambrosia.
Maine; District of Columbia.

39. **O. ochromediana** Kearfott. Base chocolate brown; the outer boundary irregu- r and farther out on costa; median area even ochre yellow, twice as wide on ner margin as on costa; outer two-fifths chocolate brown, a little mottled and aded with gray, but without clearly defined patches. Hind wing mouse gray. mm.
July. One New Hampshire specimen is suffused with ochre yellow, with the ual marks just traceable.
New Hampshire to Pennsylvania.

40. **O. murina** Packard. Mouse color, dusted thickly with luteous scales. Head d thorax darker; fore wing with small obscure pale luteous costal spots, becom- g paler toward apex; forming a very vague fascia from beyond middle of costa anal angle; fringe also pale. Hind wings pale, dusky toward apex. 20 mm.
Of this species I have seen only a single fragmentary specimen. It appears to a suffused form of the *capreana* group.
Straits of Belle Isle, Labrador. Reported as common.

41. **O. hemidesma** Zeller. Cu_2 leaving cell three-fourths way out, deep red-brow with a slight pink iridescence. A short fragment of an oblique antemedial choc late-brown fascia on inner margin; a complete narrow median fascia, slight irregular on outer side, from middle of costa, the band narrowing and fading o toward inner margin. Hind wing fuscous brown. 16 mm. (*Euchromia* Zeller).

July. Larva webbing leaves and flower heads of Spiræa.

Maine to Pennsylvania and California.

42. **O. hebesana** Walker. Dull fuscous brown, somewhat mottled; the grou with a slight purple tint, the bands perceptibly darker, and not iridescent, mix with some black scales. Base of the darker duller brown, its outer bounda irregularly excurved; median fascia narrow at costa and especially at inn margin; broad above the middle, where it extends out in two broad blunt teeth upper and lower sides of cell. With traces of gray striæ outwardly and usual a faint grayer subterminal patch; often with a suffused blackish area ov middle of costa. 9–16 mm. (*Penthina fullerea* Riley.)

June to end of September. Larva on Tigridia, verbena, Antirrhinum, Stachy pitcher plant, and iris; doubtless a general feeder. Dwarf specimens of th species have been determined as *conditana* Walsingham, which apparently is real purely a western species.

Maine to North Carolina and California. New York: Crosby (Yates County Ithaca, Nassau, New Windsor.

43. **O. dæckeana** Kearfott. Deep shining blue-gray, almost black; the markin a mixture of deep dull brown and black; so far as traceable as in *O. hebesan* Hind wing blackish. 16 mm.

June. Larva on pitcher plant. This may be a variant form of *O. hebesan* which has been bred from the same food.

Southern New Jersey and Chicago, Illinois.

44. **O. cyanana** Murtfeldt. Brownish black, heavily scaled with shining de blue. Base largely blue, with groups of blue scales and striæ before and beyon middle of costa; a large patch near anal angle, more than half the width of th wing, formed of two or three partly confluent blue spots or streaks; a few blu striæ at apex. Hind wing blackish, paler toward base in male. 15 mm.

May to July. Larva on rose.

Quebec to Missouri and Pennsylvania.

45. **O. agilana** Clemens. Blackish, irregularly scaled with yellow-brown and little chocolate brown, leaving a vague darker shade at middle of costa, and a oblique subterminal band resting on middle of outer margin. A vertical lea gray stria, perpendicular to costa, resting on anal angle and extending half wa to costa; also with some scattered lead-gray dots and striæ on outer half wing. Fringe dark gray, with black basal line; hind wing blackish with pa fringe, becoming pale on basal half. 10–12 mm.

May to July. Larva not rare in stem of Impatiens.

General. New York: Portage, Potter Swamp (Yates County), Ithaca.

46. **O. auricapitana** Walsingham. Similar to *O. agilana;* head and collar co trasting ochre-brown; fore wing with rather more ochre scaling, especially at ape Lead-gray scaling coarser and sparser, the principal marks being oblique ant and postmedial costal bars, a broken bar across the apex, and the one at th anal angle (which is heavier than in *O. agilana*). No black line in fringe, bu with a contrasting series of alternating black and yellow terminal dots.

June; August 1.

New York and New Jersey. New York: Ithaca.

47. **O. albiciliana** Fernald. Crisply mottled with bright ochre yellow and blac more coarsely than in the *coruscana* group, which it approaches. Numerou coarse scattered blue spots, partly defined with yellow; two oblique streaks towa apex on costal half of wing, tending to slightly overlap two parallel erect streak

dorsal half of wing. Fringe on costal half nearly white, with faint basal line; dorsal half dark gray, cut with white at anal angle. Hind wing dull gray th broad white fringe; basal half whitish. 12 mm.
June and July. Larva purple, a leaf roller on Spiræa.
Maine and Ontario to Pennsylvania.

18. **O. nubilana** Clemens. Dull fuscous, sometimes with a distinct reddish tint; th clearly defined but not contrasting darker brown markings. Basal markings ght, the most distinct a streak in fold; median band broad, deeply dentate on ter side, ending in a right-angled point between fold and **A**; a subterminal ot rather above the middle of wing; usually also a right triangle in shape, t sometimes oblique and narrower; a slight spot at anal angle. Outer margin the fore wing often perceptibly concave. Hind wing concolorous. 15–20 mm.
June to August.
Distribution uncertain. There are one or two closely related undescribed ecies, one of which has been taken at Ithaca, besides the following.

49. **O. infuscata** Heinrich. Wing form as in *O. constellatana*, with outer margin fore wing nearly straight, but apex more rounded than in *O. nubilana;* hind ng more or less trapezoidal, with outer margin sharply bent near middle. Dark scous brown, a little powdery looking. Median fascia vague and slightly rker; subterminal bar across apex darker, a little more distinct; some dark ading at apex; and a series of dark spots along costa, separated by short paired le striæ, all inconspicuous. Hind wing concolorous, with slightly paler fringe. mm.
Ithaca, New York.

30. *PHÆCASIOPHORA* Grote

(*Sciaphila; Sericoris; Olethreutes,* in part)

General structure and pattern as in Olethreutes. M_3 and Cu_1 of hind wing con- ite. Hind tibia of male with dense masses of long hair above, and between urs below; hind metatarsus with long dense hair above.

1. **P. confixana** Walker. Ground light olive-brown, rarely red-brown, striate with ile luteous; typically blackish with longitudinal pale striæ toward the base. ntemedial band a bundle of striæ, strongly excurved, and breaking up toward ner margin; postmedial usually of two stronger partly fused striæ, outwardly lique to beyond the cell, tangent to a white spot at the end of the cell, then arply curved and inwardly oblique to the fold, and curving out again to the inner argin; some paired subterminal striæ on costa, and blackish terminal dots. ind wing fuscous brown. Fore wing sometimes, especially in the female, of a armer red-brown tint, with the basal portion concolorous. Outer striæ of the ntemedial, and basal striæ of the postmedial line meeting just above the inner argin, in clearly marked specimens separating the darker median area from ie margin. 18 mm.
May to August.
New Hampshire to Virginia and western Pennsylvania. "New York" (Grote).

2. **P. niveiguttana** Grote. Hind tibia but little enlarged. Ground red-brown, it into irregular spots and patches by bands of pinkish ochreous edged with ellowish white; the brown areas defined with black. The most continuous brown rea a median fascia, deeply notched on the outer side above the cell and on the ner side below the cell, and extended out at end of cell, where it con- ins a white discal bar. Subterminal patch usually large and forked below, atch at anal angle small. Hind wing mouse gray. 17 mm. (*Olethreutes* auct.).
Late May. Larva on sassafras and hamamelis.
Massachusetts to Florida. "New York." (Fernald).

31. *CYMOLOMIA* Lederer

(*Exartema* Clemens; *Eccopsis*, in part)

Similar to Olethreutes; hind wing with a thickened and specialized folded lo on inner margin (fig. 267) projecting beyond the general outline of the win but quite variable in size. Hind wing with M_2 strongly curved, but often we separated from M_3 and Cu_1, which are connate at origin.

The numerous species as a whole show excellent genitalic characters, but the have not been fully worked out, and the present arrangement is tentative, awai ing Heinrich's revision of the Olethreutes group. On the whole a single speci seems to prefer a single food-plant, but the rule is not absolute, and too litt breeding has been done.

The pattern in most of the species is characteristic. The ground is of somewhat lighter shade, usually becoming quite pale along the edges of th markings and tending to be dusted with paler scales and broken into striæ. It usually slightly shining or iridescent. The markings are usually laid on broader shades and have definite boundaries, often edged with dark; they a often shaded with yellow, or paler brown or gray, but rarely powdery, ar hardly ever striate. The thorax and basal third usually show a confused mixtu of the two colors, ending in an excurved antemedial line, which may run to th costa, or turn in to the base below the costa; the median band is typically broa in the middle, where it extends out in two long teeth along the upper and low edges of the cell; and is usually deeply constricted or divided below the low tooth, often cutting off a large dorsal spot. The upper tooth and costal portio are also often cut off as a separate oblique patch. There is an oblique subtermin patch or fascia, running from below the costa to the middle of the outer margi and also a series of small costal spots beyond the median band, the second or often joining the subterminal fascia, and the fifth one apical. There is a patc at the anal angle, sometimes connected with the dorsal end of the media patch, especially if the latter is separate from the rest of the median band. Th hind wing is almost constant, being mouse-gray with a pale fringe. The basal lin of the fringe on the fore wing is continuous, often fading out toward the an angle; the outer part is usually blackish at the apex and at the end of the sub terminal fascia, and pale between and at the anal angle, but is often wholly dar

The genus is almost wholly North American, with a couple of species i Europe.

Key to the species

1. Fore wing rather evenly marked with numerous wavy transverse lines. 1. *monetiferan*
1. Fore wing irregularly marked.
2. Large smooth brown patches on basal fourth and near apex of costa. 34. *ferriferan*
2. Without two large smooth brown patches.
3. Thorax red-brown, contrasting with ground color of wings; rarely, wit only the posterior tuft brown.
4. Base of costa contrastingly pale.....31. *ochrisuffusan*
4. Base of costa grayish.
5. Fore wing with stem of cubitus and three or four veins subterminall pale; base of inner margin not brown.....32. *quadrifid*
5. Fore wing with a broad pale shade on Cu only; base of inner margi with a red-brown patch.....33. *inornatan*
3. Thorax concolorous.
4. Most of wing almost evenly blackish, contrasting with the pale, clearl marked outer margin.....10. *concinnana* var. *terminan*

4. Basal three-fourths not suffused with blackish.
5. With a distinct pale fascia of even width, formed of a group of striæ.
6. Ground black-brown or yellow-brown, lightly shaded with pale brown; the antemedial fascia white and strongly contrasting.
7. Fascia to anal angle lead-gray, not contrasting. 2. *fasciatana.*
7. Fascia running to anal angle, white, broader and strongly contrasting ..... 4. *micantana.*
6. Ground brown, with pale ochreous ante- and postmedial fasciæ.
7. Bright tawny brown..... 3½. *electrofusca.*
7. Dull umber brown..... 3. *rusticana.*
6. Ground half olive and half blackish, with no yellow or brown. 9. *appendicea.*
6. Ground light brown with olivaceous tint, often heavily flecked or suffused with cream; the fasciæ hardly paler than the rest. 8. *olivaceana.*
5. Antemedial fascia concolorous with outer markings generally, or absent.
6. Ground pure white, the borders irregularly blackish, except on outer part of inner margin and base of costa..... 21. *malana.*
6. Ground not white.
7. A black apical dot and sometimes an oblique bar at basal angle the only contrasting markings..... 24. *exoleta.*
7. Apical dot minute or absent.
8. Dorsal margin contrastingly dark, the boundary sharply defined, at least on basal half.
9. Dorsum black or brown, reaching to anal angle..29. *nigrana.*
9. Dorsal shade gray, fading out at middle of wing. 30. *clavana.*
8. Dorsal margin not contrastingly dark.
9. An oblique blackish patch at basal angle; the other markings mostly diffuse ..... 23. *cornana.*
9. Patch at basal angle, if present, no more conspicuous than costal markings.
10. Basal patch not reaching costa, and sharply defined on upper side.
11. With a narrow streak in base of cell Sc, separate from the basal patch.
12. Ground rusty orange, shot with purple. 28. *nitidana.*
12. Markings light olive on basal half, bright ochre and contrasting on apical half.....27. *fagigemmeana.*
12. Markings bright ochre, with a slight olive tint, ground paler and scaled with gray. 26. *ferruginana.*
12. Ground varying from ochreous to gray with slight olive tint (like *C. permundana*).
13. Dorsal part of median fascia contrastingly smoother-looking and paler than other markings. 25. *tiliana.*
13. Dorsal part of median area not contrasting. 29. *nigrana.*

11. Patch simple and extending at least up to R.
12. Median fascia blackish at costa only, ground pale. 22. *punctana*
12. Median fascia blackish, as a whole.
13. Fascia almost, but not quite, reaching inner margin 35. *footiana*
13. Fascia enlarged into a squarish patch at inner margin, narrow above.....20.
10. With dark base reaching costa, or a dark antemedial line running through to costa.
11. Median dorsal spot separate from rest of dorsal fascia, united with anal spot to form a thick bilobed patch 10. *concinnana* (part), 11. *foedana*
11. Median dorsal spot separate from anal one, the median fascia usually complete.
12. With strong black bars in the two teeth on the costa, half of the median fascia, the dorsal half pale and obscure; ground pale.....12. *atrodentana*
12. Without contrasting black streaks across the median fascia.
13. Gray-brown; median fascia broken into spots, and most markings somewhat suffused, but subterminal spot large, dark, and a little contrasting .....19. *merrickana*
13. Subterminal spot not more prominent than other markings.
14. Fringe rusty orange toward base, contrasting with the gray ground.....14. *corylana*
14. Fringe concolorous, or gray, black, and white
14½. Costal half of median fascia blackish, contrasting .....18½. *melanomesa*
14½. Costal half of median fascia not blackish.
15. Bands bright rusty ochre, much brighter than the gray ground .....17. *sericorana*
15. Bands lighter ochre, with a slight olive tint; in darker specimens showing as an overlay over dark brown.....8. *olivaceana*
15. Ground and bands two shades of deep red-brown; rough-looking .....13. *zelleriana*
15. Nearly even deep rusty brown, interrupted by narrow streaks of the lead-gray ground. 7. *quebecensis*
15. Leaden purple, with chocolate brown markings. *brunneopurpurata*
15. General effect grayish brown, variable in shade.
16. A distinct fine dark wavy stria just before outer margin, from apical dot to anal angle, interrupted only by the oblique subterminal bar.....15. *hippocastana*
16. No continuous stria close to outer margin.
17. Thorax and dark bands of fore wing, especially the antemedial one, mottled with little groups of clay-colored scales. 10. *concinnana*

17. Thorax more evenly colored; dark bands more smoothly overlaid with the paler color, or evenly colored.
18. Olive, with contrasting blackish base and middle of costa...9. *appendicea.*
18. Fuscous, with a slight olive tint, the dorsal half of the median area only, contrastingly paler.....25. *tiliana.*
18. Fuscous, more or less olivaceous, but with the markings mottled and all of one color..5, *furfurana,* 6. *fraternana,* 16. *permundana,* 18. *sciotana.*

Palpi closely upturned to beyond vertex; not clavate; hind wing with a well-developed process but not lobed at **2d A**; *fore wing without Cymolomia pattern.*

1. **E. monetiferana** Riley. Wood-brown, with clay-colored thick double striæ, parated by wood-brown lines, and edged with black; the bands basal, antemedial, ostmedial and subterminal, all irregular and broken. Palpi with a gray longitu-nal streak or a shade at base only and dot at base of second segment. 15–20 mm.
End of May to June.
Western Pennsylvania to Alabama.

Palpi clavate and obliquely upturned, the second joint rather tufted at the end above and below; hind wing often notched at **2d A**; *always with more or less complete Cymolomia pattern.*

* *Not notched at* **1st A** *and lobed below.*

† *Pale or gray antemedial fascia most prominent.*

2. **C. fasciatana** Clemens. Black-brown; a transverse white antemedial fascia more or less distinctly made up of striæ, nearly even in width, but widening to ne costa, its inner boundary sharply bent above cell, and running in to costa, or, more rarely, continued to the base along **R**, leaving the base of the costa white. Median area broadly blackish, the anal spot fusing in with the median band, separated from it by an obscure lead-gray bar, visible only in certain lights; subterminal fascia lighter brown, its upper part fusing with median area; the region between these two and anal angle nearly filled by a vertical lead-gray bar. Apical region whitish, with a black apical dot. Line in fringe brown-black. 15 mm.
June and July. Larva on Rumex.
Common and generally distributed. New York: Otto, Rock City (Cattaraugus County), Ithaca, New Windsor.
This species is easily confused with Olethreutes of the *fuscalbana* group, they are duller fuscous and black, and have the outer fascia much sharper and more contrasting.

3. **C. rusticana** McDunnough. Similar to *C. fasciatana* and the *fuscalbana* group of Olethreutes. Blackish ground overlaid here and there with ochre-yellow scales, but dominantly chocolate or umber brown; antemedial fascia composed of four clay-colored striæ, not nearly as white as in *C. fasciatana;* postmedial similar, running to anal angle; the spot of the ground color before it on the inner margin cut off from the median area by a lead-gray band. Median band two-toothed opposite cell with a deep notch between, as in *O. polluxana,* and the other Cymolomias. 15 mm.
July.
Northern States. New York: Peru, Ithaca.

3½. C. electrofusca Heinrich. Similar to *C. rusticana;* but with the dark portions evenly overlaid with ochre, giving a bright, tawny brown effect; th pale ground with a suggestion of pinkish iridescence.

End of May to July. Larva on sweet fern.

New Hampshire to New Jersey. New York: Ithaca.

4. C. micantana Kearfott. Similar to *C. fasciatana.* Ground nearly even dar brown, the gray band between the anal spot and the median fascia, and the gra band at the anal angle both replaced by powdery whitish fasciæ which join th whitish apical suffusion and separate the subterminal fascia widely from th median area.

June. Larva on dogwood.

Apparently more common northward. New York: Ithaca.

5. C. furfurana McDunnough. Color and appearance as in *C. permundana* genitalia as in *C. rusticana.* Slightly more greenish olivaceous than *C. permundan* with the pale areas more strigate with darker lines and dashes, the marking distinctly outlined with pale ochreous. Teeth of the postmedial band very long, th upper one almost touching the subterminal band, which does not reach the cost 16 mm. (Not examined.)

June.

Vicinity of Ottawa, Canada.

6. C. fraternana McDunnough, another species with the appearance of *permun dana* and genitalia of *rusticana,* is unknown to me.

†† *Almost wholly brown.*

7. C. quebecensis Heinrich (Kearfott ms.). Rather bright deep tawny brow (the "Vandyke brown" of Smith's glossary); evenly colored; antemedial band o two narrow dark lead-gray striæ; median, subterminal, and anal spots separate by an irregular narrow lead-gray marking, the subterminal fascia not separat from the costal region, and reaching the anal angle, with only a short stri between it and the concolorous brown apex. The usual costal striæ hardl visible; fringe and hind wing unusually dark, mouse gray. 13 mm.

Quebec; type only seen.

††† *With normal Exartema pattern; a part of the markings sometimes somewha suffused. Dark base reaching costa, or gradually fading out toward costa without definite upper boundary* (Exartema).

8. C. olivaceana Fernald. Markings almost completely overlaid with slightl duller ochreous, the fascia narrower, silver-gray and cream, not contrasting; oute markings similar, a little narrower, yellower, and less contrasting than in *C. linei fasciana.* 15 mm.

June and July. To the naked eye the whole Cymolomia pattern is more dis tinct than in other members of this group.

General in distribution. New York: Ithaca, New Windsor (Morton).

9. C. appendicea Zeller. Ash gray with a slight olivaceous tint, unlike all th similar species of the *fasciatana* and *permundana* groups by the complete lac of any yellow or brown tint. Base and median fascia above fold and apical do blackish, strongly contrasting with the olive subterminal and anal markings, an the olive or obscure dorsal part of the median fascia.

June. Larva on oak.

Kearfott considered this a synonym of *versicolorana* Clemens. McDunnoug calls attention to the whitish base of the costa mentioned in the original descrip tion of *versicolorana,* and treats it as distinct. I have not seen *versicolorana* a identified by McDunnough. Presumably it belongs to the *malana* or *nigrana* group as defined by the pattern.

Canada to North Carolina, west to the Pacific. New York: Rock City (Cattaraugus Country; aberration with pale antemedial fascia), Trenton Falls.

10. **C. concinnana** Clemens. Pattern typical. Median band interrupted below lower tooth and, rarely, above it also; its dorsal portion normally attached to the anal patch, forming an M-shaped spot. Ground light gray-brown, somewhat shaded with blue-gray and, heavily mottled with luteous, in little groups of scales, the markings rather broadly edged with the same luteous; markings shading from fuscous brown to blackish, not contrasting, except usually for the blackish upper end of the median fascia. Palpi shaded on outer side with fuscous. Fringes of fore wing generally darker than in *C. permundana*. 14 mm.

In variety **terminana** McDunnough (*doxcana* Kearfott ms.), the fore wing is blackish with contrasting pale margin.

June and July. Larva on blackberry.

New Jersey to Ohio. New York: Ithaca, West Farms (Angus).

C. mediopartita Heinrich is a similar species described from Virginia. It appears to lack the dark shade at the middle of the costa.

11. **C. foedana** Clemens has not been certainly recognized. It is purple-gray, marked with dark brown, like *C. permundana*, and is even smoother looking, not even showing the usual darkening at the middle of the costa, but has the pattern and size of *C. concinnana*. The costal spots are blackish, and the subterminal fascia is usually crossed with fine black lines. The fringe is dark, with a blackish line. 18 mm.

August. Something like this in the National Museum has been bred from alder in Virginia.

Toronto, Ontario?, Manitoba?, western Pennsylvania.

11½. **C. brunneopurpurata** Heinrich. Ground metallic leaden purple; markings rich dark brown, narrowly edged with white; pattern as in *C. permundana*. Antenna with blackish spots on upper side of first four or five joints. 14 mm.

August. Larvæ on alder in July; tying the young terminal leaves. Pale greenish yellow, with segments transversely banded with pink. Head and cervical shield pale yellow.

Virginia.

12. **C. atrodentana** Fernald. Ground pale clay-color, somewhat striate with black. Markings light gray-brown, with a slight olivaceous tint; basal third heavily shaded, striate, and mottled with blackish on the clay-colored ground. Median band normal, but very narrow, and olive at the inner margin; the olive part sometimes a separate spot, its upper half, and especially the two teeth which are long and narrow, suffused with black, contrasting.

13. **C. zelleriana** Fernald. Ground dark shining gray, heavily mottled with red-brown, of the same shade as the markings; basal area strongly mottled with the ground color. Markings orange-brown with crimson iridescence, the base strongly mottled, the outer markings rather even. Median fascia with inner side more irregular than usual, teeth blunt and rounded off, the lower one usually scaled with black. Outer markings extensive and tending to join, cutting the ground into irregular streaks and spots, but sometimes normal. 16 mm.

July and August. Larva crumpling leaves of white birch, in May (Kearfott).

East River, Connecticut; New Jersey; Pennsylvania. New York: Portage.

14. **C. corylana** Fernald. Light clay-color, with a slight greenish tint, dusted and shaded with light gray, obliterating the basal markings and most of the median fascia, the gray shade running from the base to the middle of the costa, leaving the base of the costa and the middle of the wing light. Dorsal part of median fascia, and anal and subterminal patches evener, pale dull gray, not at all contrasting, but finely defined with pale; last three costal dots dark, the apical one contrasting. Fringe with strong pinkish-to-rusty iridescence in basal half. 15 mm.

June to July. Larva on hazel.

New Hampshire to New Jersey, Manitoba, and Missouri. New York: Ilion, East Aurora.

15. **C. hippocastana** Kearfott. Luteous, rather striate with gray, a little shining. Markings brown, shaded with blackish, well contrasted, and all about alike. Thorax with well-marked transverse banding; median band strongly indented, rarely broken, narrow toward inner margin. Palpi of the lighter ground color, with base of second segment black. 20 mm.

June. Larva on buckeye, in May.

Distinguished by its coarse mottling, and tendency of the markings to break up, especially toward the base, as in Phæcasiophora.

Black Mountains, North Carolina

16. **C. permundana** Clemens. Markings normal. Ground shining gray, somewhat mottled with brown and luteous, the markings edged with luteous, decidedly smoother looking to the naked eye than *C. concinnana*; the general appearance dull brown. Markings rather dark brown, with a slight olivaceous or tawny tint; even, occasionally, with the lower tooth a little shaded with blackish. Thorax mottled, but less strikingly than in the last two species. 16 mm.

This name has been generally used to include forms not distinctively named, and even after the removal of Kearfott's recent species, is still a little heterogeneous; but the differences are probably of strain rather than of species. *Sciotana*, *hippocastana*, and *merrickana* could be united with this species with very little violence.

Larva on raspberry and Opulaster (Rosaceae) and on huckleberry. Moth in July.

Generally distributed and not rare. New York: Ithaca.

17. **C. sericorana** Walsingham. Shining gray, marked with bright rusty orange, the marks covering fully two-thirds of the wing surface, and finely pale-edged. Base mixed gray and orange, the area reaching costa. Some black scaling in lower tooth of median fascia and in subterminal and anal spots. Occasionally with the blackish dominant, and orange only in the median fascia. Hind wing and palpi as in *C. permundana*. 16 mm.

July. This species appears to intergrade with *C. permundana*.

New Jersey and Pennsylvania. New York: Ithaca.

18. **C. sciotana** Heinrich (Kearfott ms.). Outer part of second segment of palpus heavily dark-shaded. Ground dark blue-gray, nearly even, the markings narrowly pale-edged. Markings dark brownish gray, not strongly contrasting, nearly normal; the base as usual a mixture of the colors of ground and markings; the median band deeply constricted on cell, and normally broken by extensions of the luteus edging, also *quite obscure toward the inner margin, where the pale edging disappears*. 20 mm.

June and July.

Southern Ohio.

C. subnubila Heinrich, a similar species from hazel, is not now before me. It is described from New Jersey and Maryland.

18½. **C. melanomesa** Heinrich. Light wood-brown, the ground somewhat gray and with a slight pink iridescence. Markings essentially as in *C. permundana;* darker brown, the median fascia at the costa, the teeth, and the middle of the subterminal fascia, strongly suffused with blackish; the lower tooth especially prominent and almost cut off from the medial fascia. 16 mm.

The darkening of the upper part of the median fascia is the most conspicuous character for this species. It is superficially intermediate between *permundana* and *merrickana*, and according to Heinrich has genitalia of the *permundana* type.

July.

Maine to New Jersey. New York: Ithaca.

19. **C. merrickana** Kearfott. Light fuscous gray, the markings hardly darker than the ground. Base fuscous, less mottled than usual, the antemedial line bent at a right angle over the cell, and strongly oblique to the costa and inner margin.

Medial fascia normally broken up into three separate spots, the costal one quadrate and brown, the medial one much farther out and shading into blackish, usually widely separated from the other two, and the dorsal one rounded, light fuscous, and not always reaching the inner margin. Apical portion of wing usually shaded with brighter brown, the subterminal fascia normal, chocolate brown heavily shaded with black, contrasting. 20 mm.

June and July. Larva on witch-hazel.

The breaking up of the median fascia would group this form with *corylana*, which is smaller and paler, and has the outer reddish shade confined to the fringe. The records for "Black Mountains, North Carolina," were apparently based on a misidentification which has since been corrected, as there are no specimens so labelled in the series at New York.

General, west to Wisconsin and south to Virginia. New York: Crosby (Yates County), Ithaca, Portage (red variety).

†††† *With normal Exartema pattern. Base of costa of the ground color, with a contrasting dark basal patch resting on inner margin and usually sharply defined on upper side* (*diffuse in* exoleta).

20. **C. ————.** Grayish brown, with a distinct pink tint; rather smoothly colored. Markings black-brown and strongly contrasting. Basal third of ground color, with an oblique blackish bar running up from basal angle to middle of wing one-third way out; normally sending a spur back toward the base along the fold. Median fascia black-brown, the inner boundary sharply bent at **Cu**, where a pale line crosses it along the lower edge of the cell and separates it into a costal and a dorsal portion; lower tooth long and narrow, arising from the point where the two portions meet, typically connected narrowly with the lower portion, which is a large squarish patch. Anal patch very small and not contrasting; subterminal fascia normal. Palpus largely dark. (*zelleriana* Kearfott, not Fernald).

21. **C. malana** Fernald. Pure white, somewhat mottled with fuscous and a little blue-gray. Inner margin shaded with fuscous to two-thirds, with a rough-looking black bar resting on basal angle; middle of costa shaded with fuscous, with costal part of median fascia showing darker; apex and outer margin shaded with fuscous. Usual marks obsolete. A dark dot at end of cell. 12 mm.

Larva on apple and plum, in terminal buds and on leaves. Moth in July.

Apparently general, but rare and local.

22. **C. punctana** Walsingham. Light clay-color, shading into whitish; a large blackish patch resting on base of inner margin, extending up over fold and base of cell to middle of wing at a third of the way out; connected by a vague dark shade to a quadrate blackish patch on middle of costa, this patch representing the costal end of the median fascia and the region just beyond it on the costa. Middle of median fascia obsolete, dorsal part, and anal patch represented by rounded smooth pale olivaceous patches, hardly darker than the ground. Apical part of wing suffused with fuscous, obscuring the subterminal fascia. Hind wing distinctly lobed, but not nearly as strongly so as in *C. footiana*. Black dot at end of cell contrasting in the typical race from California; often obscure in eastern specimens.

June to July. Larva on Cornus.

California; southern Connecticut; New Jersey. New York: East Aurora.

23. **C. cornana** Heinrich (*cornutana* Kearfott ms.). Clay-color, a little duller and more even than in *C. punctana*. A strong oblique black bar from basal angle to fold a third of the way out; a black dot at angle of cell; median band indicated by a faint darker shade, not forming a defined patch on the inner margin; anal

and subterminal patches also obsolete, the latter, when at all traceable, round rather than barlike. Hind wing distinctly paler at base. 16 mm.

July. Larva on Cornus.

Northern New Jersey. New York: Ithaca.

24. **C. exoleta** Zeller. Clay-color, with a more or less distinct oblique fuscous shade resting on basal angle; powdery at edges; without definite boundary. A contrasting round black dot at apex, twice as large as the usual apical dot, and only preceded by very faint paired striæ. 16 mm.

June and July; late August. Larva reported from hazel and gooseberry.

Generally distributed and not rare. New York: Ithaca.

†††† *Markings of usual Cymolomia pattern; basal area formed of a patch below* R, *and a slender dark stripe in base of cell* Sc, *separated by a distinct pale line; costa pale*

25. **C. tiliana** Heinrich (Kearfott ms.). Ground blue-gray with a slight violet tinge, flecked with brown, the markings slightly olivaceous brown and edged with clay-color, exactly as in *C. permundana*. Median patch usually with costal portion, including the long upper tooth, separated from the second tooth and dorsal portion. Fringe of hind wing white. 18–20 mm.

June and July. Larva on basswood.

The basal patch in this species is sometimes as in *C. permundana*, but it is distinguished by the even and finely white-edged dorsal part of the median fascia, normally contrastingly paler than the other markings.

Northern New Jersey to Missouri. New York: Ithaca.

26. **C. ferruginana** Riley. Bright ochre, with a slight olive tint; the ground a little grayer, paler, and more powdery than the markings, which are crisply pale-outlined. Median fascia broken into costal and median streaks and a dorsal patch, the latter fused with the anal patch. 15 mm.

Originally reported as bred from Hydrangea; but the type in the United States National Museum is labelled "plum."

New Jersey to Missouri.

This form and the next two are very possibly mere color-varieties of a single species.

27. **C. fagigemmeana** Chambers. Like *C. ferruginana*, and with similar pattern. Markings on basal half of wing light olive, including the dorsal half of the median fascia and anal spot; costal part of fascia and apical spot light ochre, contrasting. Ground grayish, also paler in the apical region.

Larva a bud worm on beech.

Pennsylvania; southern Ohio; Kentucky.

28. **C. nitidana** Clemens. Ground rose, strongly shot with violet; markings bright tawny brown. Markings mostly normal; lower end of median band usually separated and fused with anal patch to form a large M-shaped patch. Hind wing of male with anal angle markedly lobed, though less so than in *C. footiana*.

July.

Pennsylvania and southern Ohio; doubtless widespread.

29. **C. nigrana** Heinrich. Ground varying from light pinkish brown to dark purple-gray, with dark chocolate brown to black-brown markings, clean-cut and strongly contrasting. Markings normal, mostly as in *permundana;* anal patch triangular, often fusing with lower end of the median fascia, which touches the inner margin beyond, leaving a narrow triangular area of the ground color along the inner margin beyond it. Dorsal third of wing frequently contrastingly darker. Hind wing markedly paler toward base. 20 mm.

July and August.

Generally distributed. New York: Geneva, Ithaca.

C. ornatana Kearfott, reported from New Jersey in Smith's list, is unknown to me. It is presumably a manuscript name, and equal to one of the other names in this group.

30. **C. clavana** Walker. Clay-color, a little powdery; a contrasting fuscous shade along whole costa, becoming wider and blackish at middle; a fuscous shade along basal two-thirds of inner margin, sharply limited at fold toward base, becoming diffuse outwardly. Outer margin less strongly dark-shaded, but with dark fringe. Usual markings obsolete, the subterminal fascia only defined, but very slightly darker than the ground. Thorax blackish, but less intensely so than in the preceding form. 16 mm.

July and early August.

Quebec; New York; New Jersey; Kansas. New York: Ithaca.

†††††† *Thorax partly or wholly bright brown, contrasting with the greater part of the fore wing; the brown also appearing along costa, and at basal angle of fore wing. Usual markings not contrasting, and medial band incomplete, or wholly obliterated.*

31. **C. ochrisuffusana** Heinrich (Kearfott manuscript). Ground light gray-brown, markings dark mustard yellow or ochreous toward base, brighter ochre-brown toward margin. Head and thorax yellow-brown. Basal patch large, diffuse toward costa, when most distinct forming an oblique shade resting on basal angle. Base of costa down to cell and out to two-fifths, the palest part of wing. Medial fascia obscure, represented by spots at costa, end of cell, and on fold; subterminal and anal patches normal. 18 mm.

June.

There is also a dull brown form distinguished by the pale base of costa and obsolescent median fascia.

Southern Ohio, Illinois, Kansas.

32. **C. quadrifida** Zeller. Thorax dull gray anteriorly, becoming bright brown (burnt sienna) on the tufts, or all brown. Fore wing pale dull gray, somewhat powdery, with strong pale veins, especially on disc, costa, apex, and inner margin; shaded with rusty brown; the costa cut with fine paired striæ, but the other normal markings lost. Hind wing whitish at base. 18 mm.

June and July. Larva on Cornus.

Massachusetts to Illinois. New York: Peru, Ithaca.

33. **C. inornatana** Clemens. Thorax mostly rich red-brown, usually showing the gray ground only at the base of the tegulæ. Fore wing gray, shaded with a vague paler streak through the middle of the wing and running into a large pale area at the anal angle. Veins not paler. Costa a little shaded here and there with brown; basal angle with a large fleck of bright brown, extending up to A. Usual markings often indicated only by partial pale outlines, the pale, excurved, and waved antemedial line most distinct. Anal patch often perceptibly paler than ground. Median band, when traceable, broken up into spots. 18 mm.

June to August. Larva on wild cherry.

New Jersey to western Pennsylvania. New York: Ithaca.

††††††† *Antemedial patch contrasting, bright brown, with straight outer boundary; Cymolomia pattern lost.*

34. **C. ferriferana** Walker. Ground powdery light gray; thorax and base of fore wing mahogany brown; the outer boundary straight, or nearly so, from cell to inner margin; usually bent in toward costa. A large trapezoidal brown patch on outer half of costa, half as wide as the wing, not quite reaching apex, but touching outer margin at middle, enclosing a gray apical triangle. Sometimes with the dark patches black-brown. 16 mm. (*gratiosana* Clemens).

June. Larva on Hydrangea.

Pennsylvania to North Carolina.

** *Hind wing of male markedly notched at* **1st A**, *with a strong lobe below, whose apparent length is increased by its much longer fringe; outer margin more oblique, and apex more extended than usual.*

35. **C. footiana** Fernald. Fore wing fuscous, marked with black-brown. Thorax fuscous; basal patch large, prominent, not reaching costa; medial band broad toward costa, and especially over cell, the teeth well marked but not very long, then abruptly narrowing, and usually not reaching inner margin; the lower end lighter, chocolate brown. Anal patch narrow and normal, or absent; subterminal bar normal. 20 mm.

June to August. Larva on witch-hazel.

New York to western Pennsylvania and Virginia. New York: Hemlock Lake, Ithaca.

32. *BACTRA* Stephens

Palpi large, broadly hairy, and beaklike, about as in Ancylis; eyes normal; thorax smooth. Fore wing smooth scaled; outer margin oblique, slightly arched, or straight. All veins separate and evenly spaced; M_2 perceptibly separate from M_3 at origin; Cu_2 nearly straight. Hind wing normal (fig. 268), **R** and M_1 stalked at origin, then usually approximate a third way to margin; space between M_1 and M_2 wide, as usual; M_2, M_3, and Cu_1 close together at origin, but perceptibly spaced. No secondary sexual characters.

The genus is nearly world-wide, and perhaps, like Limnæcia, Australasian in origin. All the known larvæ are borers in rushes (Juncus), but seem to stray to other marsh plants.

1. **B. verutana** Zeller. Clay-color to dark wood-brown; costa and dorsal margin with fine blackish dots and striæ, and slightly heavier bars representing the antemedial and postmedial bands. Wing surface with some fuscous flecking, a blackish shade or spot in fold at one-third way out and one over lower angle of cell, often enclosing a pale discal dot. Frequently a pale longitudinal stripe below the costa. Terminal line usually continuous and perceptibly wavy, followed by a series of very short white scales in extreme base of fringe. Fringe often showing several parallel gray lines. Wing often longitudinally streaked toward margin. 9–15 mm. (*lanceolana* of American authors.)

May and June; August and September. Larva normally in Juncus, but reported also from Cyperus and Scirpus.

Indiana to North Carolina and south.

2. **B. furfurana** Haworth. Wings a little narrower, with more oblique outer margin; fore wing clay-color to wood-brown, the markings tawny to gray-brown; base dark, with outer boundary abruptly bent in cell; an irregular postmedial fascia, sharply bent on cell or lost below middle of wing, enclosing a pale or white discal dot; the markings frequently barely traceable. Usually with a spot at anal angle; almost always with a shade running to the apex. Terminal line as before. 10–16 mm.

Larva on Juncus and Scirpus.

General in distribution; also occurring in Europe. New York: Ithaca.

3. **B. priapeia** Heinrich. Larger than *B. verutana* and *furfurana*, costal striæ fine and obscure, not much emphasized at middle; fore wing frequently all dark brown, typically with a longitudinal blackish shade from base to apex, leaving the anal angle contrastingly pale. Palpus with a fuscous spot on second segment and dark third segment. 16 mm.

July; September.

Woods Hole, Massachusetts, to Utah.

4. **B. maiorina** Heinrich. Similar to *B. priapeia*, but paler. Ochreous; head and front of thorax paler, the palpus whitish; fore wing with a fuscous shade

from base to apex; costa faintly barred with fuscous; a small white discal dot. Fringe dusted with fuscous. 13–20 mm.

June and July; September. Larva on Scirpus and grass.

Virginia; Indiana; Utah.

33. *POLYCHROSIS* Ragonot

(*Eudemis* auct., *Chrosis* Guenée)

Similar to Olethreutes; no secondary sexual characters; hind wing (fig. 269) with M_3 and Cu_1 distinctly separated at origin.

The moths are three-brooded, typically leaf rollers in habit, and also feed on flowers and fruits when in season. The moths of the various species are very similar to each other and difficult, sometimes impossible, to name without the food-plant. They show the Cymolomia pattern, but the base is more consistently of the ground color, with a brown antemedial fascia only; the median band has only the lower tooth on the outer side, and is broad, gradually narrowing to the inner margin; the upper tooth is usually replaced by a small separate spot. The subterminal patch is usually very large and broadly oval. It is doubtful if all these names will stand as species; some of them are perhaps rather food-varieties. Polychroses have also been bred from several other plants, but have not been described as distinct (figs. 269, 282).

Key to the species

1. Hind wing white, fuscous at apex only; fore wing irregularly mottled and shaded with white ..... 1. *yaracana.*
1. Hind wing fuscous, sometimes darker toward margin, or blackish; no white.
2. Subterminal patch evenly broad-elliptical, with only a few black scales on outer margin, resting broadly on outer margin ..... (8) *botrana.*
2. Subterminal patch separated from outer margin by a streak or patch of the ground, except at upper side, where it sends a spur obliquely down to margin; more rarely, entirely separated from margin.
3. Basal half of fore wing blue-gray, with narrow dark brown antemedial and broken basal lines only.
4. Fringe light brown, concolorous with paler parts of wing.
5. Pale edging of lines gathered to form a pale dot above tooth of median fascia ..... 9. *magnoliana.*
5. Area above tooth of median fascia mostly dark gray. 9. *liriodendrana.*
4. Fringe dark blue-gray, sometimes with light spots in its outer portion.
5. Hind wing contrastingly pale, whitish, at base .... 10. *cypripediana.*
5. Hind wing dark gray, hardly paler at base.
6. With a dark postmedial patch or short fascia ..... 7. *rhoifructana.*
6. With confused markings beyond upper end of median fascia, in part longitudinal streaks ..... 8. *viteana.*
3. Base of fore wing with blue ground, crossed by a strong basal line and a broad dark brown antemedial fascia.
4. Dorsal third or half of pale antemedial fascia heavily shaded with light luteous, showing to naked eye as a pale spot ..... 4. *carduana.*
4. Antemedial fascia of ground color, wholly gray, or with the luteous only finely edging it.
5. Dorsal half of median fascia ochreous, a third as broad as width of wing, showing as a contrasting pale patch ..... 5. *aruncana.*
5. Median fascia all dark, or narrowing to a point at inner margin.

6. Median fascia markedly paler dull brown toward dorsal margin, the markings edged or suffused with wood-brown (larva on Compositæ, etc.) .....2. *slingerlandana*, 3. *ambrosiana*.
6. Median fascia evenly black-brown, the markings very narrowly and incompletely pale-edged (larva on Rosaceæ) 6. *spiræifoliana*.

Polychrosis has also been bred from clematis, Kalmia, Amorpha, raspberry, sassafras, rose, Circium, and Monotropa. Some of these records are doubtless of stray larvæ, but some may represent new species or strains.

1. **P. yaracana** Kearfott. Ground blue-gray; markings blackish, broadly edged with white; basal third largely blackish. Costal part of median fascia nearly black, contrasting, followed by a darker blue-gray area toward costa, forming a patch visible to the naked eye; dorsal part of fascia obliterated by a white spot. Hind wing white, the fuscous apical shade only reaching half way to cell. 9 mm.

May and June. Larva unknown.

New York to Cincinnati, Ohio. New York: Gowanda.

2. **P. slingerlandana** Kearfott. Shining dark blue-gray; markings black-brown, heavily edged with wood-brown, and more or less suffused with the same wood-brown, especially on outer two-thirds of dorsal half. Base markedly grayer, but still heavily marked. Apical spot blackish, fringe dark gray; hind wing blackish, with dark fringe. 9 mm.

Larva on Eupatorium, working especially in flowers and seed.

New Jersey, etc.

3. **P. ambrosiana** Kearfott. Dark blue-gray, marked with blackish; the marks finely pale-edged, but antemedial space not contrastingly pale; base less darkened than in *P. carduana*. Markings normal, subterminal patch well set back from the outer margin, which bears a strong blackish streak, usually joined at one point to the subterminal patch; postmedial costal patch normally broken into a couple of oblique striæ. 9 mm. (*vernoniana* Kearfott).

Larva in flowers and seeds of *Ambrosia trifida*, and on Vernonia.

New Hampshire to District of Columbia, and west to Kansas.

4. **P. carduana** Busck. Dark blue or purple-gray; markings normal, black-brown, finely pale-edged, with a well-marked postmedial costal patch. Base almost solidly blackish, contrasting with the antemedial area, which is light clay-color on the dorsal half; median band a little paler toward inner margin and of moderate width; subterminal patch large and dark; fringes and hind wing dark gray. 9–12 mm.

Larva in the heads of thistle; semisocial.

Maryland; Normal, Illinois.

5. **P. aruncana** Kearfott. Dark blue-gray, marked with dark brown, the markings mostly normal and finely pale-edged. Base dominantly blue-gray, but with a broad antemedial fascia. Median fascia broad and light wood-brown to ochreous on dorsal half; more than a fourth as broad as wing at dorsal margin. Postmedial patch broken into striæ; brown. Fringe and hind wing dark gray. 7 mm. (Specimens perhaps dwarfed by breeding.)

Larva on Aruncus (Spiræa).

Maryland.

6. **P. spiræifoliana** Heinrich (Kearfott ms.). Larva on *Spiræa salicifolia*. Markings normal, black-brown on a dark blue-gray ground, with only slight traces of pale edging. Terminal fascia heavy. Median fascia wholly black-brown, the tooth not very strong; subterminal patch very high, joining one of the black-brown costal striæ (which are all thick bars) and reaching nearly or quite to anal angle. Fringe and hind wing dark. 9 mm.

May; August.

New Hampshire to Pennsylvania.

. **P. rhoifructana** Kearfott. Normal in markings with dark base, closely similar *riteana*, but with a vertical postmedial bar resting on the costa, and dorsal half the median fascia much browner than the costal end. 11 mm.
The first brood in May. Larva in seed heads of Rhus, and on Cornus and lmia.
Kennebunkport, Maine; Ohio. New York: near Rochester.
8. **P. viteana** Clemens. Normal in markings. Base blue-gray, with basal line rdly distinct, and antemedial brown band narrow and weak and broken. Mark-gs dull umber brown, shaded with blackish, the subterminal patch dark brown or ckish, markedly darker than the ground. Markings finely edged with luteous, dorsal end of the median fascia narrow, and somewhat suffused with luteous, wood-brown. Costal region beyond median fascia with confused markings, re or less defined by pale longitudinal streaks; without a distinct costal patch t with a couple of minute costal dots instead; apical dot black-brown; fringe ep shining blue-gray, hind wing fuscous, a little paler at base. 10 mm.
The larva lives on grape. The first brood usually works in the flower clusters, e other two, in the grapes (for this reason it is called the "grapeberry moth"). sually the larva works in two or three grapes, webbing them together, or attaching leaf to the hole. It may also live as a case-bearer, eating out the Anthonomus ll and utilizing it as a case (Clarke).
Generally distributed and injurious. New York: Chautauqua County (Felt), haca, Karner, and Orient Point.
P. botrana Schiffermüller is probably confined to the Old World. It is a much ler species, with the costal half of the antemedial fascia whitish, leaving a gray rsal antemedial patch. American records are based on various species of this nus.
9. **P. liriodendrana** Kearfott. Similar to *P. viteana:* the outer part of the wing ith pinkish suffusion on the ground, and the markings, including the apical dot, ght brown. Postmedial costal spot well defined; fringe light wood-brown. Hind ing rather light, with whitish fringe. 9–12 mm. Larva on Liriodendron and agnolia.
New Jersey to District of Columbia.
The variety **magnoliana** Kearfott has the pale edging of the markings heavier nd forming a distinct pale spot above the tooth of the median fascia. This ariety occurs with the type on both food-plants.
10. **P. cypripediana** Kearfott. Basal half mostly dark blue-gray, with the ante-edial band of moderate width; markings dull fuscous, dominant on outer part wing, with fine pale edging, but hardly any pale shading. Markings normal, ostmedial costal spot distinct, subterminal spot narrow, mostly well separated om outer margin. Hind wing dirty white, noticeably darker than in *P. yaracana*, ith the fuscous apical shading extending in to the end of the cell. 10 mm.
Larva on Cypripedium.
Seen from Manitoba only, but doubtless to be found in our area where its food-ant is found.

Subfamily **TORTRICINAE**

The arrangement of this subfamily follows approximately that of Meyrick in he *Genera Insectorum*.

34. *SPARGANOTHIS* Hübner

(*Œnopthera* Duponchel; *Œnectra* Guenée, not Hübner; *Cenopis* Zeller etc.; with *Platynota, Leptoria* Clemens, *Epagoge* auct.)

Front with a projecting tuft, leaving a more or less circular, naked or close scaled area covered by the palpi (fig. 240); which are beak-like and typically as long as head and thorax together. Fore wing (fig. 234) normally with some raised scales, becoming regular tufts in group Platynota; R_4 and R_5 forking over apex; Cu_2 arising beyond middle of cell. Hind wing with a distinct tuft or fringe of hair-scales on base of **Cu**, weaker than in most Eucosminæ; **R** and M_1 approximate and often shortly stalked; M_2 closely grouped with M_3 and Cu_1, and widely separated from M_1.

Key to the species

1. Ground white.
   2. Immaculate ..... 19. *pettitana* var.
   2. A large brown patch ..... 16. *niveana*.
1. Ground lemon yellow.
   2. A brown spot on middle of inner margin ..... 20. *albicaudana*.
   2. No such spot.
      3. Reticulate with orange or red-brown.
         4. Hind wing blackish ..... 10. *lycopodiana*.
         4. Hind wing light gray ..... 9. *sulfureana*.
         4. Hind wing pale orange or white.
            5. Fore wing with narrow bands of red-brown ..... 14. *reticulatana*.
            5. Fore wing with large areas of red-brown ..... 15. *ferreana*.
      3. Not reticulate with orange, or with only a few brownish scales.
         4. Hind wing ochreous white ..... 18. *karacana*.
         4. Hind wing pure white.
            5. A broad curved band, both ends of which run to costa .. 17. *groteana*.
            5. Narrow broken bands, or none ..... 19. *pettitana*.
         4. Hind wing gray.
            5. Fore wing with three rusty stripes ..... 11. *tristriata*.
            5. Fore wing with an oblique rusty band ..... 8. *puritana*.
1. Ground duller or darker.
   2. Base of fore wing pale orange, outer part dark.
      3. Base defined by a blackish band; with a blackish triangular apical shade ..... 2. *flavibasana*.
      3. Markings wholly diffuse; no blackish ..... 1. *violaceana*.
   2. Hind wing dull orange or orange brown, or white suffused with orange.
      3. With obscure dull purplish reticulation only, not contrasting. 22. *testulana*.
      3. With well-marked dark reticulation ..... 21. *chambersana* (female).
      3. Light yellow, with light brown patches ..... 12. *saracana*.
      3. Dull light tawny and darker brown; sexually dimorphic. . . 26. *flavedana*.
   2. Dull orange, hind wing white ..... 21. *chambersana* (male).
   2. Base concolorous with medial or terminal region; hind wing not orange or pure white.
      3. Ground bright yellow or orange.
         4. Not reticulate; with oblique dark band ..... 8. *puritana*.
         4. Yellow, reticulate with orange; or orange, reticulate with yellow.
            5. Fore wing with narrow bands of red-brown ..... 14. *reticulatana*.
            5. Fore wing with large areas of red-brown ..... 15. *ferreana*.
      3. Cream yellow, reticulate with purple-brown.
         4. Patchily shaded also ..... 4. *irrorea*.

4. Evenly reticulate .....7. *caryæ*.
3. Ground duller brown or gray.
4. Pale brown, with blurred antemedial and postmedial costal patches, or immaculate in female.....5. *xanthoides*.
4. Very small; brown, with darker, rather even and sharply defined bands .....13. *diluticostana*.
4. Dull dark gray, heavily tufted, and marked with blackish.
5. Blackish with luteous outer margin.....24. *semiustana*.
5. Blotched with whitish.....25. *exasperatana*.
5. No pale areas.....23. *idœusalis*.
4. Pale powdery gray.
5. With brown inner margin.....(*Amorbia humerosana* female).
5. No brown inner margin.....6. *cana*.

Fore wing with isolated scales or raised striations only, sometimes practically smooth.

Front normal, the enclosing tuft of long, incurved hairs, not quite regularly arranged (Sparganothis).

1. **S. violaceana** Robinson. Fore wing with basal two-fifths light yellow, edged ith copper-red iridescence; the next two-fifths dull gray with purple iridescence; nd the apex brown with green and red iridescence, all shading into each other. ind wing dark. 20 mm. (*Tortriæ, Œnectra*).
May to July.
Quebec to Pennsylvania and British Columbia. New York: Peru, Rock City Cattaraugus County), Ithaca, Schoharie, Karner (Forbes).
2. **S. flavibasana** Fernald. Base coppery, notched by a very large square fuscous atch a third way out on costa; most of wing dull brown; apex triangularly lackish, and also hind wing and fringe. Normally with the square costal patch onnected by a fuscous band to inner margin near base, crossing the coppery area.
June. Larva on Lonicera.
Ottawa, Ontario; Illinois; Texas.
[Number 3 is vacant.]
4. **S. irrorea** Robinson. Typically light straw yellow, much less brilliant than ie *sulfurcana* group; with a large purple-brown patch beyond middle of inner argin, a smaller one opposite it on costa, often connected to it by a curved line, nd costal edge and fringes dark; the patches not sharply defined. Ground often otted with purple-brown. Hind wing pale. 22 mm.
June to early August.
Quebec to Pennsylvania and British Columbia. New York: Otto, Ithaca.
5. **S. xanthoides** Walker. Pale brown, typically reticulate and finely veined with ark brown; in variety **breviornatana** Clemens, with orange-tinted ground, and iore heavily reticulate; male with two distinct costal patches of the brown, the asal one tending to become an oblique fascia across the wing, or to join a patch ver **Cu** at the middle of the wing. Female with the patches obscure. Hind wing ariable, dirty white to gray. Very near *S. irrorea*, and perhaps intergrading with t, but more buff-brown, with the patches less clean-cut on inner side when present, specially the lower one.
New Hampshire and Ottawa, Ontario, to Pennsylvania and British Columbia. New York: Newcomb, Portage, Potter Swamp (Yates County), Liberty, Big ndian Valley, Putnam County, New Windsor.
6. **S. cana** Robinson. Pale gray, with dark shading forming more or less dis- inct quadrate patches on base, before and beyond middle of costa, and rather eyond middle of inner margin; ground striated with black, the striation more efinitely transverse than in *A. humerosana*, and defining the antemedial costal,

and the dorsal, patch with black. Hind wing slightly browner. 20mm. (*Tortri*
Cenopis.)

This species is superficially very like *Tortrix afflictana.*

Pennsylvania. New York (Fernald).

7. **S. caryæ** Robinson. Cream color, regularly reticulate with red-brown; n
forming oblique bands; hind wing lighter red-brown. 22 mm.

June to September. Larva a general feeder.

Maine; Illinois; Missouri; Alabama; Texas. New York: Lewis County.

8. **S. puritana** Robinson. Bright ochre yellow, with an oblique even red-brow
fascia from costa before middle of inner margin; a spot on costa at two-thir
and one at middle of outer margin. Fascia usually broken in the fold, especiall
in the large western race, **vocaridorsana** Kearfott. Expanse typically 18 mm
the race *vocardidorsana* often over 25 mm. (*Crœsia.*)

End of June; August.

Quebec to Massachusetts and west. New York: Newport, North Creek, Well
Ithaca, Trenton Falls, Karner.

9. **S. sulfureana** Clemens. Lemon yellow, more or less reticulate with orange
the reticulation sometimes almost completely lost; base of costa, two rust brow
or black fasciæ meeting at middle of inner margin at an angle of 60°, the outer
one often angulate or forked, and often an irregular outer margin; hind win
gray, or more or less shaded with orange, never pure white. Quite variable an
tending strongly to break up into strains. 10–15 mm.; southern specimens (variet
belfrageana Zeller) averaging very small. (*Epagoge.*)

Generally distributed, flying from June to September and the commonest of th
genus. Larva a general feeder.

New York: Newport, Honeoye Falls, Buffalo, Portage, Ithaca, Big Indian Valley
Liberty, Pearl River, New Windsor; East New York, Long Island.

10. **S. lycopodiana** Kearfott. Markings similar to *S. sulfureana*, heavier, th
red-brown often suffusing the whole outer half of the wing, and the bands cen
tered with dark brown (as in some specimens of *S. sulfureana*). Hind wing dar
mouse-gray. 12–13 mm. (*Epagoge.*)

July and August. Larva on Lycopodium.

This form is fairly constant; it may be an extreme strain of *S. sulfureana*, bu
is quite distinct from its ordinary forms.

Ottawa, Ontario; Hampton, New Hampshire; Sebec Lake, Maine.

11. **S. tristriata** Kearfott. Lemon yellow, all margins, and a band through cel
from base to outer margin, red-brown. Outer margin rarely yellow, merely reti
culate with orange. Hind wing reddish gray. Fore wing rarely rusty orange
with grayish streaks.

September. Very rare.

Minnesota; New York; Maryland.

S. bistriata Kearfott ranges north to North Carolina. It has two wide stripes
and a weak one on the inner margin, and a light brown hind wing.

** *Front in male flattened or slightly concave, close-scaled, and produced into a*
point between the palpi; with the hair overhanging it all cut off even, forming
a regular horseshoe-shaped tuft, so as to make the front appear deeply con
cave (fig. 240); *female with the same structure less developed, much as in*
some males of the typical group (Cenopis).

12. **S. saracana** Kearfott. Very dull light ochre with a square light brown patch
a third way out on costa, and a band from outer third of costa to beyond middle
of inner margin, widening into patches at the ends and sometimes broken at the
middle, or broken into three spots. Hind wing browner. 18 mm.

July. **Larva on sassafras.**

Essex County, New Jersey.

There is a closely related undescribed species from Philadelphia, Pennsylvania.

13. **S. diluticostana** Walsingham. Red-brown, with even, alternating bands of faint purplish and golden iridescence, defined by narrow lines which are not iridescent; the bands of moderate width toward outer margin, about as broad as ing toward base. Hind wing reddish gray. 13–16 mm. (*quercana* Fernald).

June and July. Larva on oak, cherry, and syringa.

New York to Texas. New York: Newark, Batavia, Otto, Ithaca.

14. **S. reticulatana** Clemens. Anterior half of tegulæ red-brown; front of thorax with a transverse orange bar. Fore wing lemon yellow, reticulate with orange, sometimes almost entirely orange; a dark band from costa at one quarter way out to beyond middle of inner margin, more oblique than in *sulfureana;* a costal patch at two-thirds way out, sending a forked line from its lower side; one leg of this line joining the lower end of the first band, and the other running to near the anal angle and usually fading out; margin with a dark stria. Hind wing white, typically suffused with orange. Very close to some forms of *sulfureana,* but apparently distinguishable by the outer patch on the costa and the pale hind ring; also rather like *Eulia quadrifasciana,* which has separated orange dots instead of reticulation. 15 mm.

Not rare in July and August. Larva a general feeder.

The dark, dominantly orange form is typical, the yellow one is variety **gracilana** Walsingham.

Generally distributed. New York: Wilmington, Fentons (Lewis County), Hope, Newport, Otto, Hemlock Lake, Ithaca, Albany (variety *gracilana*), North Creek (typical).

15. **S. ferreana** Busck. Near *S. reticulatana.* Ground reticulate with rusty brown on pale straw yellow, suffused with brown except on basal third; a large semicircle on middle of costal margin, leaving a narrow oblique antemedial band and a terminal band. Hind wing white with ochreous tint.

July.

Ilion, New York.

16. **S. niveana** Walsingham. Reddish brown with bright purple iridescence; a basal patch, a conspicuous spot on middle of costa, and outer margin, white. Hind wing pale ochreous brown, with white margin and fringe. 23 mm.

The type is unique and is possibly an aberration of *S. groteana.*

Canada.

17. **S. groteana** Fernald. Lemon yellow; a large triangular patch on middle half of costa, extending down to fold and enclosing a semicircular yellow spot; sometimes with a series of brown postmedial striations. Rarely, with middle half of wing suffused with yellow-brown, except the costal spot, or with the brown reduced to a couple of striæ on costa, which tend to converge, unlike maculate forms of *pettitana* and *karacana.* 30 mm.

Western Pennsylvania to Manitoba.

18. **S. karacana** Kearfott. Lemon yellow with transverse water-lining like that of *S. pettitana,* of which it may be a maculate variety, but unlike *S. groteana;* a narrow brown fascia from one-third way out on costa to beyond middle of inner margin, and a patch on costa at two-thirds way out tending to send out lines toward inner margin. Normally not at all striate. Fore wing rarely suffused with tawny brown, showing the yellow only on the basal half of the inner margin, the outer margin, and a couple of spots toward base of costa. 20 mm.

Bayberry and scrub oak.

New Jersey. New York: Batavia.

19. **S. pettitana** Robinson. Pale lemon yellow, water-lined with raised scales, typically immaculate, sometimes with two more or less complete parallel oblique lines. Ground, rarely, pure white or shaded with pale brown. 20–27 mm. (H **48**:35.)

Common and general in distribution. Larva on various plants, especially ma
New York: Rochester, Batavia, Rock City (Cattaraugus County), Little Fa
Schenectady, Pine Island; Great River, Long Island.

20. **S. albicaudana** Busck. Lemon yellow, mottled with slightly darker yell
antemedial line fine, pinkish brown, starting from a small triangle on costa
third way out, and running to the inner angle of an irregular pinkish bro
patch on middle of inner margin. Postmedial line two-thirds way out, irregu
but roughly parallel to antemedial as far as Cu_2, then fading out, or curving
and joining the outer end of the dorsal spot. A little brownish reticulation o
wardly. Fringe pinkish brown. Hind wing cream-white, slightly shaded w
orange. 15–18 mm.

July. Larva on maple. This form is doubtless the extreme maculate vari
of *S. pettitana*.

Notch, Pennsylvania.

21. **S. chambersana** Kearfott. Dull orange, reticulate with dull red-brown,
reticulations gathering into a broken fascia from before middle of costa to beyo
middle of outer margin, and a vague spot at end of cell. Hind wing white in ma
orange in female. 20–25 mm.

June. Larva on Cercis. This form is superficially very close to *S. xanthoid*
but is distinguished most easily by the lack of grayish tint on the hind wi
It seems to fit rather better in group Cenopis than in typical Sparganothis.
also resembles *S. testulana*, but is brighter, and has a paler hind wing.

Cincinnati, Ohio.

22. **S. testulana** Zeller. Bright orange, reticulate with light brown; with
slight purplish iridescence, not at all contrasting. Indications of an obliq
median fascia, and a discal spot. Hind wing light orange. 16–22 mm.

June to August. Larva on oak and walnut.

Missouri to New Jersey and south.

II. *Fore wing with heavy tufts and scale ridges and a conspicuous costal fold, t
strongest tufts being two in the fold and one at the end of the cell. Eyes lar
in male* (Platynota).

* *Costal fold moderate.*

23. **S. idæusalis** Walker. Ash gray, irregularly shaded with blackish and du
brown; the striæ markedly raised and black; male tending to have the out
margin paler, with two or three fine striæ; female rather paler on the basal ha
out to an oblique black stria across the middle of the wing. Hind wing fuscou
12–25 mm.; female averaging much larger. (*Hypena* Walker; *sentana* Clemens

General in distribution; June to August; not rare. Larva on Solanum, golde
rod, clover, and other herbs; in a folded leaf or between two leaves; cuttin
the petiole of one leaf and feeding on it when withered and dry.

New York: North Creek, Otto, Itnaca, McLean, Big Indian Valley, New Windso
Clove Valley, Long Island.

24. **S. semiustana** Walsingham. Basal part of wing almost solid blackish, co
trasting with the luteous margin, which has two black striæ. Some yello
brown, mixed with the blackish base. Hind wing a little browner than i
S. idæusalis.

Male only seen. Possibly a variety of *S. idæusalis*.

New Hampshire; North Carolina.

25. **S. exasperatana** Zeller. Similar to *S. idæusalis*, but with costal half an
outer margin of male whitish, except for a semicircular dull black patch on outer
half of costa. Female with basal half whitish, and middle of costa also froste
with whitish; hind wing whitish in male, mouse gray in female. 12–15 mm.

July and August.

New Hampshire; Texas. New York: Ithaca.

*** Costal fold extending beyond middle of wing.*

26. **S. flavedana** Clemens. Male black-brown, with contrasting reddish-ochreous ater fourth; female red-brown, almost evenly marked, as in *S. idæusalis;* hind ing red-brown. 10–20 mm.
Larva a general feeder.
Common and generally distributed. New York: Putnam County, New Windsor, ew York City; Clove Valley, Staten Island, Jamaica, Long Island.

35. *AMORBIA* Clemens

(*Hendecastema* Walsingham)

Similar to Sparganothis; R_4 and R_5 united in male, running to costa; palpi xceeding head by less than twice the width of the eye, even in female. Larvæ leaf-ollers, like Sparganothis, etc., general feeders.
1. **A. humerosana** Clemens. Whitish gray, slightly mottled in two shades, and lotted with minute black scale-tufts; inner margin brownish. 21–30 mm. H 48:23.)
Rather common in May and June.
General in distribution. New York: Ilion, Crosby (Yates County), Ithaca, IcLean, Big Indian Valley, New Windsor, Long Island.

36. *CŒLOSTATHMA* Clemens

(*Amphisa*)

Male antennæ heavily bristled and fasciculate; palpi moderate, beaklike; no ostal fold. Fore wings with R_3 shortly stalked (fig. 235); Cu_1 well separated from M_3 and both Cu_1 and Cu_2 strongly curved; base of M and of R_{4+5} lost. Hind wing with R and M_1 stalked; M_2 and M_3 connate; Cu_1 widely separated from M_3. An isolated genus, resembling both Sparganothis and Capua.
1. **C. discopunctanum** Clemens. Fore wing distinctly falcate; dull luteous, typically with outer and inner convex fine brown lines, somewhat outwardly oblique and shaded beyond with dull light brown; the inner line tending to break into costal and dorsal patches, the outer to become diffuse. Sometimes with large brown shades beyond the inner line at costa and inner margin, and beyond the outer line at the costa. 15 mm.
June to August; apparently two broods with maxima in July and in August. Larva on clover.
Quebec to Florida and west. New York: Newcomb, Ilion, Otto, Ithaca, Schenectady, Rhinebeck.

37. *ADOXOPHYES* Meyrick

(*Capua,* in part)

Male antennæ ciliate; palpi beaklike, the third joint moderate and downcurved; thorax with a slight crest behind; fore wing of male with large costal fold; R_4 and R_5 stalked, forked over apex; Cu_1 arising well before angle of cell; hind wing in our species with R and M_1 stalked; M_3 and Cu_1 separate.
This genus is rather close to Sparganothis, both in structure and markings; but the peculiar frontal scaling is not suggested, the frontal vestiture being smooth.
1. **A. furcatana** Walker. Pale straw yellow, reticulate with golden brown; a light brown, oblique and quite irregular fascia from before middle of costa to before anal angle, about as wide as two interspaces on the cell; below which it

sends off a fine branch toward the basal angle; a second oblique and nearly ev fascia from three-fourths way out on costa to anal angle, obscurely joining the fi one below; well defined on inner side, but gradually shading into the pale ap Hind wing white. 18. mm.

June to September.

Mississippi Valley; east to western New York: Ithaca.

Eastern race. Paler; the ground between the reticulations very nearly whit oblique fascia much narrower, and darker brown, practically reduced to a coup of anastomosing lines, with a strong branch extending to inner margin about third of the way out; outer fascia farther out, excurved and connected to the inn one by irregular brown reticulations.

Maine to western Pennsylvania.

38. *ARGYROTOXA* Stephens

(*Tortrix,* in part)

Similar to Tortrix, but with scale tufts on the fore wings, the tufts being on a little raised, the one at the end of the cell perhaps most prominent; R_5 runnin practically to the apex.

Argyrotoxa is closely related to Peronea, which differs only in R_5 running clear to the costa; and which has a similar pupa. The species are superficially ver close, but have perfectly distinct genitalia. Larvæ of the genus are known fro rose, oak, huckleberry and other foods.

Key to the species

1. Fore wing with a raised yellow discal spot ..... 3. *curvalan*
1. Fore wing with discal spot inconspicuous.
   2. Fore wing with a subterminal band.
      3. Subterminal band closely parallel to outer margin, leaving a narrow ye low margin ..... 1. *bergmannian*
      3. Subterminal band more strongly curved, drawing away from margi toward costa, where it is about as far from the apex as twice the widt of an interspace ..... 2. *albicoman*
   2. No subterminal band ..... 4. *semipurpuran*

1. **A. bergmanniana** Linnæus. Bright lemon yellow; a brown transverse ban from a third of the way out on costa to before middle of inner margin; one fro two-thirds of the way out on costa to before anal angle, these two breaking int orange reticulations below costa; a third contrasting dark band closely parallel t the outer margin, leaving a narrow yellow margin; the wing sometimes suffuse with dull orange, leaving the margin and costal region pale. Hind wing white o yellowish. 10–12 mm.

Larva greenish white, with black head, cervical shield, and true legs; webbin together the terminal leaves of rose.

I am not quite sure this species really occurs in America, as the records may b based on specimens of *albicomana*, which is very close.

2. **A. albicomana** Clemens. Closely similar to *A. bergmanniana*, save for th greater curvature of the subterminal band.

Larva on rose.

Distribution uncertain, from confusion with the other species. New York: Nort Elba, Batavia, Rock City (Cattaraugus County), Ithaca, Albany, Rhinebeck Crugers, New York City, Staten Island.

3. **A. curvalana** Kearfott. Rich tawny brown, leaving the base and outer margi yellow, and a conspicuous longitudinally oval discal spot at lower angle of cell.

Mississippi Valley.

4. **A. semipurpurana** Kearfott. Typically purplish gray, with the base, outer margin, and a patch at middle of costa yellow; varying to forms that are wholly yellow, with the usual markings showing as a different shade of yellow, or merely as waterlining. Sometimes with whitish markings, or with orange bands.

Larva on rose and oak.

General, and somewhat commoner, as a rule, than *A. albicomana*. New York: Ithaca, common.

Variety **dorsipurpurana** Kearfott. Mostly pale yellow, but with a narrow contrasting blackish shade along inner margin, widening more or less distinctly into teeth ante- and postmedially.

With the typical form. New York: Ithaca.

39. *PERONEA* Curtis

(*Acleris, Teras, Acalla, Rhacodia, Teleia* Hübner; *Cheimatophila* Stephens; *Alceris* Fernald, in Dyar's List)

Similar to Tortrix; as shown by the pupa closely related to Argyrotoxa. Fore wing with all veins separate, R_5 running to costa (fig. 236), Cu_2 arising from well before middle of cell; the lower boundary of the cell beyond it strongly upcurved; hind wing with **R** and M_1 approximate, M_2 low, M_3 and Cu_1 connate or shortly stalked. Thorax sometimes tufted; costa normally nearly straight, sometimes arched, notched at middle in subgenus **Rhacodia** (*emargana, effractana*), especially in the female.

Variation in some of the species is extreme; and the key can apply only to the more usual forms. There are two or more broods, the adult hibernating. For the larva see figure 244.

Key to the species

1. Fore wing with a broad notch in middle of costa, and apex strongly falcate.. 24. *effractana*.
1. Fore wing with costa not notched, or slightly so in female; in the latter case, with rounded apex.
2. Fore wing smooth-scaled.
3. No localized markings; the wing regularly spotted or reticulate, or plain. 1. *minuta*.
3. With a well-marked longitudinal stripe from base to apex....2. *angusana*.
3. A dark triangle on middle of costa.....11. *comandrana*.
3. An oblique dark line or shade across cell.
4. With clean-cut lines or boundaries of dark shades at two-fifths and three-fifths way out on costa.....3. *fishiana*.
4. With such a line at two-fifths but none at three-fifths; normally with dark base .....18. *maccana*.
2. Fore wing with tufts, at least small ones in fold and beyond middle of cell.
3. Head and front of thorax contrastingly blackish.
4. Five large tufts, two antemedial, two at middle of wing, and one near end of cell; the pale parts white.
5. With contrasting white or whitish base or broad antemedial fascia. 14. *variegana*.
5. With a large black costal triangle.....13. *nivisellana*.
4. With more numerous or minute tufts, or one or two rather large ones; pale parts yellow or buff.....21. *permutana*.
3. Head and front of thorax not dark; or somewhat darkened (*logiana*), but shading into the ground color.
4. With a clean-cut diagonal scale-ridge clear across wing.

5. Ground white, lightly dusted with gray.....7. *trisignana.*
5. Ground pearl gray.....10. *chalybeana.*
4. With the scale ridge abruptly offset inward at lower edge of cell, and less below Cu_2, outward; ground white, lightly dusted with gray. 9. *nigrolinea.*
4. With the scale ridge usually absent in cell Cu_1 (next below discal cell); ground pure white.....8. *niveana.*
4. With separated tufts; when more than four in line, quite small and clean-cut.
5. Most distinct mark a triangular patch on middle of costa.
6. Ground white.
7. With connected brown reticulation and brown terminal line. 12. *americana.*
7. With separated brown dots, or a very little reticulation toward margin.....4. *subnivana.*
6. Ground gray or brown.
7. Inner boundary of dark costal patch clean-cut; head light, ground broadly grayish.....16. *schalleriana.*
7. Inner boundary of dark costal patch blurred; head deep brown. 15. *logiana.*
7. Head, body, and ground of wings concolorous, dark fawn color. 23. *ferrugana.*
7. With some slightly darker reticulation, or raised black points, or both; buff forms with the base of the wing distinctly grayer.....11. *comandrana*
7. Evenly brown, varying from pinkish cream to deep yellow-brown, or narrowly reticulate with white.....5. *cervinana.*
7. Not placed.....6. *heindeliana.*
5. Most distinct mark an oblique antemedian fascia or a longitudinal stripe.
6. With a distinct tuft in cell Cu_1, below those lying beyond middle of cell, and with outer part rough-scaled or with raised tufts.
7. Tuft in cell Cu_1 in line with the others. 19. *maculidorsana,* 18. *maccana.*
7. Tuft in cell Cu_1 basal of the others.
8. Contrastingly marked with black, gray, white, and sometimes yellow.....20. *variana.*
8. Ground pearl gray.....15. *logiana.*
8. Ground violet-gray, with a small yellow spot beyond discal tufts only.....22. *pulverosana.*
8. Ground reddish brown or reddish gray.....23. *ferrugana.*
8. Ground dull fuscous, or yellower, with red-brown markings. 15. *logiana.*
6. Outer part of wing, and usually cell Cu_1, quite smoothly scaled. 17. *hastiana.*

I. *Fore wing with smooth scaling, rounded apex, and convex to straight costa.*

1. **P. minuta** Robinson. Typically orange, the scales shining, but reticulate with dull scales; often yellow, reticulate with orange.

The moth becomes darker later in the season, successive specimens passing through red and crimson to gray with only a few scattered red dots and striæ (variety **cinderella** Riley, probably the same as *oxycoccana* Packard). The area of the dull scaling becomes less at the same time and finally disappears. 9–18 mm.; the early yellow and orange specimens usually the smaller.

Several ill-defined broods, from June on; hibernating as imagoes in the form *cinderella*. Larva with yellow head; a leaf roller in habits, injurious to cranberry; also on apple.

Quebec to New Jersey, and perhaps generally distributed. New York: McLean.

2. **P. angusana** Fernald. Varying from light yellow to tawny brown, with inner margin below **A** always grayish, and in dark specimens with other gray shades below the stripe. Stripe darker than ground, red-brown to blackish, running from middle of base to apex; more or less edged below, and often above, with slightly frayed and irregular white lines. 13–15 mm.

End of July to September.

Meach Lake, and Ottawa, Quebec; Massachusetts; New Jersey. New York: Ithaca.

3. **P. fishiana** Fernald. Dull gray, more or less distinctly dotted with brown. Two parallel fine lines from two-fifths and three-fifths way out on costa toward anal angle, each defined with slightly paler before and with a brown shade beyond. Hind wing whitish, more distinctly dotted with dark. 25 mm.

Montreal, Quebec; Franconia, New Hampshire; Maine.

II. *Fore wing with more or less raised scale tufts; the wing rounded or with subfalcate membrane only; the costa smooth-scaled, or with rough bristling scales, tending to form tufts before and beyond middle, especially in female* (Acleris)

4. **P. subnivana** Walker. White, sometimes tinted with cream, especially in female; a triangular dark patch resting on middle half of costa, tending to be broken up into three spots in very lightly marked specimens, but usually solid or with a small central pale spot; a yellow shade extending from it to middle of inner margin, at least in female. Hind wing gray, markedly darker than ground of fore wing. Costa of female concave and strongly rough-scaled both before and beyond the concavity. 13–15 mm. (*peculiana* Zeller, *deflectana* Robinson). In a variety the lower two-thirds of the wing is regularly spotted with brown between the veins.

The tufts are moderate but well marked; the costal notch of the female is the only definite difference between this species and the next. Larva on Vernonia (Cacalia).

Common and generally distributed in late fall and early spring.

New York: Wilmington, Ithaca, Albany.

5. **P. cervinana** Fernald. Similar, the ground pinkish cream to bright buff-brown, or buff-brown reticulate with white, the dark color covering a larger area than in spotted forms of *P. subnivana*. Hind wing paler, whitish, almost always paler than ground of fore wing. Wing form similar in the two sexes, without costal concavity or decided rough scaling; costal patch tending strongly to be weak below or to break into spots. 13–15 mm.

General all season; wintering as adult.

6. **P. heindeliana** Fernald. Ash gray, slightly shaded with brown below the triangular costal patch, which extends from a third to four-fifths way out on costa, and is spotted with black tufts (*gallicolana* Clemens).

Larva in "pine-cone" gall on willow.

Illinois to Manitoba. New York: Ithaca (?)

7. **P. trisignana** Robinson. White, irregularly dusted with gray, appearing pale gray, with the costal triangle often indicated by three partly confluent light gray spots. Fore wing with antemedial tufts on cell and in fold, and with rough scaling which tends to form a very irregular and broken postmedial band. A scale ridge running obliquely almost across the wing from before middle of costa to beyond middle of inner margin, narrowly interrupted on the veins, but not offset on Cu_1 or Cu_2. 15–20 mm.

This form is doubtfully distinct from *boscana* Fabricius of Europe, which is not close to our so-called *boscana* (*placidana* Robinson). *Larva* fastening together two overlapping leaves of white birch, living in a small white tube. Pale dull green; head and cervical shield black; also with blackish prespiracular and subventral warts on prothorax.

This may be merely a gray winter form of *P. niveana*.

Montreal to New Jersey and western Pennsylvania. New York: Big Indian Valley, Bronx (New York City), Staten Island, Long Island.

8. **P. niveana** Fabricius. Pure white, with a few gray scales; the tufting as in *P. trisignana*, but interrupted in cell Cu_1. 20 mm.

Larva on birch.

Europe; reported from Ontario.

9. **P. nigrolinea** Robinson. White, irregularly dusted with gray, often gathering into spots at middle of wing; typically, but not usually with a fine black longitudinal line from base to middle of wing. Tufts numerous, the outer ones forming parts of three series; the median series strongly broken at Cu_1, and less so at Cu_2. 25 mm.

This form is very probably a mere variant of *P. trisignana*.

Montreal, Quebec, to western Pennsylvania, Missouri, and British Columbia.

10. **P. chalybeana** Fernald. Tufts somewhat reduced, with wider spaces between them, but with the one in cell Cu_1 in line with the others. Costa not so roughly scaled as in *P. hastiana*. Dull gray, normally with darker shades, especially with traces of the costal triangle; sometimes with costal triangle well-marked, and a heavy blackish patch at base of inner margin. Tufts often defined with black. 22 mm.

August; October to May.

Maine to western Pennsylvania. New York: Ithaca, McLean.

11. **P. comandrana** Fernald. Tufts almost obsolete. Pale brown, with obscure striation and a darker terminal line; costal patch normally strongly contrasting, dark brown, with central triangle of the ground color, rarely suffused and broken up. 13 mm.

June; November. Larva on *Comandra bellardi*; light green with whitish protuberances, and black head and cervical shield; in early June.

Massachusetts to Texas.

12. **P. americana** Fernald. Head reddish white. Fore wing white, reticulate with bright brown, the transverse bars of the reticulation much stronger than the veining, which is only partly traceable. Costal triangle bright brown, slightly suffused below, with pale center; fringe deep brown at base, yellow-brown outwardly, contrasting. Hind wing mouse gray. 15 mm.

October.

Ontario and New Hampshire to western Pennsylvania.

13. **P. nivisellana** Walsingham. Light gray; costal part toward base and a shade about the contrasting black triangle white; apex coppery orange, with a couple of black spots. Five large transverse tufts of whitish scales and several small ones, partly black. Markings variable in extent but unusually constant for the genus. 15 mm.

Larva on Cratægus.

Generally distributed, west to British Columbia and south to Pennsylvania. New York: Ithaca.

14. **P. variegana** Schiffermüller. Head grayish or black, contrasting with the white thorax; fore wing white or yellow at base; typically, with the antemedian tuft below cell blackish, and the area between it and the inner margin gray; in the only specimen seen from this region, nearly solid white. Outer half of wing contrastingly dark, yellowish to nearly black. 13 mm.

July; larva on various trees and shrubs.

British Columbia; Europe. New York: Clinton.

15. **P. logiana,** Schiffermüller. Typically pearl gray, with a contrasting brown ostal triangle, which extends nearly to apex, and tends to run down a little along he outer series of tufts; a double point below. Tufts small. Fringe darker in ale specimens, concolorous with hind wing. Fore wing in variety **germarana** rölich gray, shaded with brown, the costal triangle not contrasting with the ther brown shades; in variety **famula** Zeller, dull fuscous with the triangle arely traceable; the fuscous ground, under the lens, showing as gray, more or ss flecked with red-brown. Fore wing in other specimens strongly shaded with ellow on the outer half (variety **viburnana** Clemens).

This complexly variable species is best determined by breeding from its food lant, Viburnum.

General in distribution. New York: Ithaca, Karner, New Windsor.

P. stadiana Barnes and Busck is unknown to me. It is described as similar to *. viburnana,* but smaller (16 mm.) with the costal triangle relatively smaller, round light reddish brown, rather heavily overlaid toward the apex with dark rown, and terminal edge dusted with black. It was described from Ottawa, anada.

16. **P. schalleriana** Linnæus. Light dull gray; with scattered small black tufts. ostal patch a clean-cut triangle, twice as long on outer as on inner side, and runcate parallel to the costa along the middle of the cell; costal patch bright rown, with some black scaling on its edges, and with two blackish bars in the ringe at its apex. 18–20 mm.

Two broods, August to April; June and July. Larva green with darker side-tripes, head and cervical shield yellow-brown, with blackish spots on sides of hield; in flowers and young leaves on Symphytum, Salix, and Vaccinium.

Quebec to Massachusetts, West to British Columbia; Europe.

17. **P. hastiana** Linnæus. Fore wing with moderate antemedial and medial ufts in cell and in fold, the medials about three-fourths way out in the cell; vith no corresponding tuft in cell Cu_1. Outer part of wing smooth scaled. Mark-ngs extremely variable, and of two principal types: either with a longitudinal tripe, which may run through the middle of the wing or rather toward the costa, r may be represented by a broad pale costal area; or with mainly transverse narkings, either contrasting or obscure, of which the most distinct is an oblique ascia between the two pairs of tufts in the cell. Ground usually violet- to brown-sh-gray, duller than in *P. variana.* 20 mm. (*celiana* Robinson).

Larva much like *P. schalleriana,* on Vaccinium and Andromeda.

Generally distributed and not rare, but thoroughly confused in collections with arious of the following species: New York: Hemlock Lake, Ithaca, McLean, lbany. (Variety *inana* Robinson occurs at New Windsor, and variety *flavivittana* lemens is also reported from New York by Robinson. A black strain occurs t McLean.)

The principal named varieties are the following:

oronana Thunberg, with whitish antemedial fascia.

yringerana Hübner, with a yellowish fascia on a red-brown ground.

sorana Frœlich, variable in ground color, with striation on the veins, and traces of dark costal triangle.

utumnana Stephens, immaculate yellowish gray to dark brown, with the dark raised tufts only.

quilana Hübner, dark, with veins finely pale and pale head and thorax.

lbistriana Haworth, with fewer or no pale veins, and a pale dorsal stripe.

ombustana Hübner, with yellow dorsal stripe.

adiana Hübner, dark, with pale veins on dorsal half, pale yellowish on costal half, with traces of dark veins.

ivisana Hübner, costal half contrastingly pale, white, or yellow, separated from the brown dorsal half by a dark line.

piciana Hübner, light brownish yellow, with a dark line from base to apex.

mayrana Hübner, the reverse of *apiciana*, being blackish brown, with a fine, clean-cut yellow or white stripe from base to apex.

centrovittana Stephens, with the yellow or tawny longitudinal stripe crossing the typical transverse pattern; which is rather clean-cut and moderately contrasting in shades of brownish gray, as in the typical form.

The forms in this list were all described from Europe, but most or all are represented in America; besides these, the following were originally described from American specimens:

flavivittana Clemens, with a yellow dorsal stripe below the fold: it may be considered the representative of *combustana*.

perspicuana Robinson, pale gray with contrasting blackish base.

celiana Robinson, red-brown with normal pattern in violet-gray; and yellowish, rather than black, tufts.

hudsoniana Walker, from west of Hudson Bay; described as blackish, with a paler quadrate patch in the cell and no other decided markings. (I have not seen it, and Kearfott notes that it is not a form of *hastiana*. A black form of *hastiana* occurs, however, at McLean, New York.)

ptychogrammos Zeller, perhaps also a distinct species, described from Texas; dwarf (15 mm.); gray, with well-marked brown costal triangle; a longitudinal black streak in fold to three-fourths, and the black triangle edged inwardly with black.

albilineana Kearfott, violet-gray, with a white stripe from base to apex, leaving a gray costal edge, and edged below with blackish. (I am not at all sure that this is a variety of *hastiana*. Very possibly the tufting is unstable and several of these nominal species should be united.)

18. **P. maccana** Treitschke. Tufts almost obsolete, but with the antemedial one in the fold distinct; a black dot or streak, sometimes slightly raised, in cell Cu_1, almost directly below the lower tuft in cell; unlike the *hastiana* series, where the tuft or dot if present is well basad of the discal ones. Dull brown, somewhat shaded and frosted with pale violet-gray; usually very slightly, but in the only specimen seen from the United States, heavily, except for the dark base and the triangular patch on costa. Two fine, somewhat irregular, oblique lines from costa, the inner at two-thirds way out, much as in *P. fishiana*, which however is perfectly smooth-scaled. 20 mm.

Larva on Vaccinium and Ledum.

Europe; Winchendon, Massachusetts.

19. **P. maculidorsana** Clemens. Light violet-gray, shaded with brown beyond the principal row of tufts, which are all practically in line. A triangular dark patch on inner margin near base, with the black tuft in the fold at its apex, as in some specimens of *hastiana*. 17–20 mm.

Variety **inana** Robinson is all light dull gray, and wholly without contrasts.

New Hampshire and New Jersey to Nevada; apparently only the variety in Nevada.

20. **P. variana** Fernald. Outer tuft in fold directly below the outer discal ones, which are more erect than in the *hastiana* group; tuft or black dot in Cu_1 far basad of them, resulting in a long inward-projecting tooth on the outer boundary of the pale antemedian fascia. Markings white, gray, and black; or often with yellow, either as a basal patch or a longitudinal stripe; antemedial fascia broad, paler, often pure white, preceded and followed by narrow blackish irregular bands, which often are contrasting.

New York to British Columbia; the larva on spruce and often very common northward. New York: Mt. Whiteface, just below the tree line.

21. **P. permutana** Dupouchel. Reddish wood-brown, shaded with yellow, especially toward base of wing; with a blackish patch near base of inner margin; and shading at apex and beyond the antemedial fascia. Tufts strong, the one toward

the base of the fold, practically filling the space from **Cu** to **A**; the outer tufts strong, well separated, and not very numerous; the one in cell Cu_1 typically much out of line with the others, but variable. **Fragariana** Kearfott applies to specimens with the tuft in cell Cu_1 practically in line. 15 mm.

Larva on Prunus, rose, and strawberry; also reported from willow.

New Hampshire to British Columbia.

P. robinsoniana Kearfott appears from the tufting to be a variety of *permutana*. The inner margin is contrasting light yellow, widening to half the width of the wing at outer margin; the rest wood-brown, shading into black on basal half toward apex.

Specimens seen from New Hampshire, New Jersey, and Manitoba.

P. clemensiana Kearfott is another probable variety; it is suffused with blackish except the large tuft on the disc and a patch at the anal angle, which are ochreous.

Hampton, new Hampshire.

P. flavivittana of Robinson, not Clemens, is another form of very different appearance; red-brown frosted with gray and white; with the inner margin from base to anal angle heavily dusted with white and marked by a fine white line.

Several other unnamed forms occur.

New Hampshire.

22. **P. pulverosana** Walker. Violet-gray, with a good many small groups of black scales, rather loosely and roughly scaled, but with small tufts. Tuft in Cu_1 hardly out of line, but moth distinguished from *maculidorsana* by its even gray color, with a contrasting yellow-brown spot in the end of the cell, defined inwardly by the black tufts. (When yellow-brown is present in *maculidorsana*, it is more extensive and diffuse.) 18 mm. (*brewsteriana*).

Massachusetts; Manitoba.

P. hypericana Ely is closely similar. The base before the tufts is grayish white, with a strong blackish patch on the base of the inner margin, covering the first tuft. The oblique series of tufts is normally followed by a strong yellow shade.

Larva on Hypericum.

Connecticut.

23. **P. ferrugana** Schiffermüller. Brown, often shaded with pale dirty gray or blackish; rarely, almost wholly of the pale gray, with scattered browner scales. Costal triangle never complete, but often marked in blackish. Tufts normal, small and clean-cut, usually of black and white scales; that in cell Cu_1 out of line. Distinguished from the *hastiana* series by its brown or brownish color, and lack of contrasting gray or yellow marks, from the *comandrana* group, by its less clean-cut costal triangle, and usually by its more decided yellow-brown tint. 15 mm.

Larva on white birch.

Semiannula Robinson is the extreme, light form; pale gray with only scattered brown scales. *P. gallicolana* Clemens, I am unable to place, but from its food habit it is more apt to be an earlier name for *heindeliana* Fernald than a synonym of this species; the description also agrees. If so, the supposed type at Philadelphia is incorrectly labelled.

Generally distributed. New York: Wilmington, Ithaca (United States National Museum), Taughannock.

III. *Fore wing with costa strongly concave, even in male, and roughly scaled before and beyond the concavity in both sexes; apex strongly falcate. Tufts as in the preceding group.* (Rhacodia).

24. **P. effractana** Frœlich. Gray, more or less shaded with reddish; sometimes largely pale reddish. 18 mm.

August. Larva green, with yellow-brown head; on poplar, willow, and birch.

Europe; Ottawa, Ontario; etc.

39½. *TORTRICODES* Guenée

Similar to Peronea. Palpi somewhat weaker and down-curved; tongue weak in our species, typically obsolescent. Fore wing with R_5 running to apex. Hind wing with M_3 and Cu_1 completely united; **R** and M_1 long-stalked.

1. **T. fragariana** Busck. Ash gray; base somewhat darker, its outer boundary strongly excurved and angled over cell; median fascia but little darker, strongly oblique, its inner boundary strongly extended in, in fold, and its outer boundary dentate. Hind wing smoky. Wings narrower and more lanceolate than in Peronea, though less so than in the type of Tortricodes.

August. Larva on strawberry.

New York to the Pacific coast. New York: Ithaca.

40. *CNEPHASIA* Curtis

(*Sciaphila,* etc.; *Tortrix, Capua,* in part)

Very close to Tortrix; fore wing usually more pointed, with extended apex and convex costa, smoothly scaled; palpi beaklike, often long. Venation like that of Tortrix, but with **R** and M_1 of hind wing stalked (fig. 239).

As defined here this is a heterogeneous group, apparently related to the lower members of Tortrix. Venational aberrations occur with **R** and M_1 free, but they can generally be identified by having longer and more pointed wings than Tortrix.

Key to the species

1. Silvery white, immaculate ..... 1. *argentana.*
1. Cream white, a little shining, immaculate ..... 2. *osseana.*
1. Tawny brown to olivaceous, with a more or less distinct oblique fascia.
2. Expanse over 18 mm. Arctic-alpine ..... 3. *mœschleriana.*
2. Expanse under 15 mm. Generally distributed.
3. A transverse subterminal fascia ..... 4. *listerana.*
3. A subterminal spot on costa only.
4. Male with a brown costal fold; female with costal edge narrowly brown below, not transversely striate toward base ..... 6. *virescana.*
4. No costal fold; the costal edge pale, and with a few slight transverse striations in both sexes; smaller ..... 5. *peritana.*

1. **C. argentana** Clerck. No costal fold. Fore wing and thorax silver white, on a fuscous base, becoming fuscous gray when rubbed; hind wing duller and yellower. 25 mm. (*Argyroptera* Duponchel.)

July.

Europe; Truro, Nova Scotia; Quebec; Colorado, and west. New York: Trenton Falls.

2. **C. osseana niveosana** Packard. No costal fold. Cream white, somewhat shining; the wings less pointed then in *A. argentana.* 20 mm. (*Ablabia* Hübner).

The larva forms a tube under stones and trash, and feeds on various low plants. The moth flies in June.

Labrador to Alaska, and southward in the Rocky Mountains. New York: Lewis County (Hill, determined by Fernald).

3. **C. mœschleriana** Wocke. No costal fold; usually with R_1 and R_5 free; rarely shortly stalked. Sometimes with **R** and M_1 of hind wing free. Light yellow, usually suffused with dull olive, red-brown, or reddish fuscous; with a strongly oblique brown median fascia and a spot on the costa near apex, obscure in suffused specimens. (*gelidana* Mœschler; *Tortrix, Capua*).

April; August.

Arctic; and on Mount Washington, New Hampshire, and other alpine summits.

1. **C. listerana** Kearfott. Brown with distinct pink iridescence; not strigose. rkings very slightly darker; golden brown with fine paler edging. A narrow urved basal fascia; median fascia narrower on costa, covering whole outer third inner margin; a convex subterminal fascia from costa almost to inner margin, ch narrower toward inner margin. Hind wing chocolate brown. 10–12 mm. (*halonia* Kearfott).
July.
Nicholson, Pennsylvania.
5. **C. peritana** Clemens. Dull ochreous brown, sometimes with a slight greenish ge, slightly striate with fuscous; a blackish band from costa at two-fifths way t to before anal angle, usually complete; and a small costal patch at four-fifths, newhat extended down by dark striations. Female not always distinguishable m *C. virescana*. 8 mm. (*Smicrotes* Clemens).
May and June; September. Generally confused in collections with *C. virescana*.
Probably general. New York: Newcomb, Otto, Ithaca, Ramapo, West Farms.
6. **C. virescana** Clemens. Similar; the male costal fold well marked, and con- sting brown; the costal edge more or less brown in female, and not striated. ound color more constantly olivaceous; oblique fascia usually reduced to a costal tch in male, and rather diffuse in female. 13–17 mm. (*Archips, Cacœcia, Smicrotes*).
The larva of a related California species eats mealy bugs (Pseudacoccus).
Common and generally distributed, a variety occurring in British Columbia.
w York: Rock City (Cattaraugus County), Portage, Crosby (Yates County), haca.

41. *HARMOLOGA* Meyrick

(*Tortrix*, in part)

Vestiture rough; the thorax with a low posterior tuft; pulpus upturned to mid- e of front, but rough above as well as below; clavate, with short third joint. o costal fold; wings loosely scaled, but without the definite raised scaling of rgyrotoxa and Peronea.
This genus was proposed by Meyrick to include a primitive group from New aland. Our species is aberrant in having M_3 and Cu_1 connate or stalked, and com- nes characters of Tortrix, Eulia, and Archips.
1. **H. fumiferana** Clemens. Mottled with clay-color and fuscous or reddish own, the western race strongly reddish; reticulate with black. Hind wing gray. –25 mm. (*nigridia* Robinson.)
The larva is the spruce bud worm, and is often injurious.
Generally distributed in the spruce zone; south to Massachusetts and northern ew York in the East. New York: Common in the Adirondack and Allegany ighlands.

42. *EULIA* Hübner

(*Lophoderus* Stephens)

Like Tortrix, but more generally with convex costa; with a well-marked posterior ift on thorax.

Key to the species

1. Ground cream.
   2. Whole middle of wing occupied by a large brown patch.....9. *alisellana*.
   2. Fine brown dots, and two parallel fasciæ.....8. *quercifoliana*.
1. Ground yellow, with red dots and fasciæ.....7. *quadrifasciana*.
1. Broadly shaded, red-brown, yellow, and olive.....1. *ministrana*.
1. Ground pale gray; a triangular blackish costal patch.....5. *mariana*.

1. Ground dark brown, with two darker fasciæ.....6. *juglandana.*
1. With complex clean-cut markings, including a broad oblique fascia.
2. Pale triangular area resting on outer margin merely striate..4. *gloverana.*
2. This pale area containing a large dark patch, or broken up.
3. Dark markings reddish only.....3. *pinatubana.*
3. Dark markings largely deep purple-gray.....2. *velutinana.*

I. *Hind wing with* R *and* M_1 *stalked* (Eulia).

1. **E. ministrana** Linnæus. Light yellow, dusted with gray so as to appear olivaceous; with vague shaded markings of orange, red, and brown, the outer margin shading into red, the most prominent brown mark a patch on middle of inner margin. Hind wing gray. 20–25 mm. (*ferrugana* Hübner).

June. Larva green with brown head; in a folded leaf on many kinds of trees and shrubs; wintering full-grown and pupating in the spring.

Generally distributed south to New York; Europe. New York: Summit and North Twin Brook (Mt. Marcy), North Elba, vicinity of Indian Pass (North Elba Township), Ithaca, Big Indian Valley.

Variety **subfasciana** Stephens, which I have not seen from America, is more evenly colored, darker brown, and frosted with whitish.

II. *Hind wing with* R *and* M_1 *separate* (Argyrotænia *Stephens*).

2. **E. velutinana** Walker. Ground nearly white, striate with gray and shaded with pale reddish; markings red-brown, striate with black, and shaded with purple-gray. A fascia from middle of costa widening to inner margin and covering the outer third of it; a blackish triangle beyond it on costa and a more or less distinct oval gray patch in the pale apical area left by the two markings. Base varying from the ground color to dark gray; when dark, defined by a well-marked excurved antemedial line; the inner margin on the basal half often shaded with gray. 12–16 mm. (*triferana* Walker, *lutosana, incertana* Clemens).

April to October. Two or three broods, with maxima in May, July, and late August. Larva a leaf roller on almost any plants except conifers; and even reported from balsam fir.

Common and generally distributed. New York: Newark, Lewiston, Honeoye Falls, Ithaca, Delmar, Albany, New Windsor, Florida.

There is a closely related, but somewhat larger undescribed species without any brown scaling. It occurs at Ithaca in May.

3. **E. pinatubana** Kearfott. Similar in markings, but with the dark marks light tawny brown or Indian red; hardly ever with gray or purplish scaling. Outer costal patch connected with the outer oval spot, so as to divide the ground into an oblique postmedial fascia, and a terminal one narrowing toward inner margin. 10–15 mm. (*politana* auct.).

Seasons as in *E. velutinana.* Larva on pines, making a cylindrical tube out of a couple of clusters of needles and feeding on the tips of the same needles, deserting the tube and forming another when the needles are eaten down to about an inch long. Pupation in the last tube or in another formed for the purpose, but without a cocoon; the pupa easily falling out.

General in distribution. New York: Peru, Portage, Ithaca. Probably common all over the State but overlooked.

Politana Haworth has the ground dull red-brown, and the fascia breaking into a small costal and a large quadrate dorsal patch; and the larva is a general feeder on deciduous plants. It is probably not American.

4. **E. gloverana** Walsingham. Similar to *E. velutinana*, larger, wing rather more acute. Ground whitish, shaded with pale red, especially toward costa, and lightly and almost evenly striate with gray. Fascia light brown, even in width; costal

riangle also light brown; and brown base, when distinct, of the same shade the vhole width of the wing. No subterminal dark area. 15 mm.

May. Probably mixed with females of *E. velutinana* in collections.

Winchendon, Massachusetts; Pacific States; not seen from the Central States. New York: Lewis County.

5. **E. mariana** Fernald. Whitish, shaded with light gray and ochreous, with large blackish triangle on outer two-thirds of costa; often breaking into two pots, representing the fascia and spot of the preceding forms. 20 mm.

May. Larva on Vaccinium.

Nova Scotia to Florida. New York: Ilion, Jamestown, Ithaca, Ramapo.

6. **E. juglandana** Fernald. Wings rather broader; the outer half of the costa straight, as in some Archips. Dark brown, crossed by two narrow parallel oblique blackish fasciæ, the second pointing toward the anal angle, but not always reaching it. Hind wing mouse-gray. 15–25 mm.

June and July. Larva on hickory and Viburnum, in May. The thoracic tuft is well marked, but very easily lost.

Quebec to Pennsylvania and Minnesota. New York: Batavia, Ithaca, New York City, Brooklyn.

7. **E. quadrifasciana** Fernald. Lemon yellow, heavily dotted with orange; with two narrow oblique red fasciæ, and outer margin often shaded with brownish red. Hind wing gray or orange. 15–20 mm.

May to July.

Quebec to Pennsylvania and Missouri. New York: Lewis County, Batavia, Albion, Ithaca.

8. **E. quercifoliana** Fitch. Cream yellow, dotted with brown; with two narrow oblique brown fasciæ, and a curved subterminal streak, sometimes connected by a streak in the discal fold to the outer oblique fascia. Hind wing white. 16–20 mm. (*trifurculana* Zeller; *Tortrix*).

June and July. Larva on oak and buckthorn, greenish white with amber-yellow head, and pale legs.

Quebec to Texas. New York: Ithaca, Big Indian Valley, Albany.

9. **E. alisellana** Robinson. Light brown with a series of more or less confluent cream-white patches all around the margin. Hind wing white. (**H 48**:39.)

June.

Quebec to Illinois. New York: Ithaca, Bethlehem.

43. *TORTRIX* Linnæus

(Restricted; with *Archips*, etc., in part)

Head (fig. 243) smoother scaled than in Eulia; thorax smooth-scaled, with scutellum rounded out, but no posterior tuft. Palpi with second joint porrect, more or less clavate, rough-hairy on upper side, and third joint porrect or beaklike. Fore wing with all veins separate (fig. 237), Cu_1 arising close to M_3, strongly curved, Cu_2 from middle of cell, nearly straight. Hind wing with **R** and M_1 approximate at origin, M_2 close to M_3 and Cu_1, which are connate at origin. Cu_2 straight, arising two-thirds way out on cell. Costal fold usually absent.

The type of the genus (*T. viridana* Linnæus) is bright green, and, except in palpi and lack of costal fold, resembles Archips; our species are all aberrant in one way or another.

Grisea and fractivittana, placed in Tortrix by Meyrick, are included here in Archips; for *peritana* see Cnephasia, and for *quercifoliana*, see Eulia.

Key to the species

1. Ash gray, obliquely banded and reticulate.....1. *afflicta*
1. Yellowish.
2. Reticulate with dark and obliquely shaded.
3. Ground olivaceous to light ochre.....5. *allenia*
3. Ground brown .....6. *symphoricarpa*
2. Not reticulate.
3. Male with costal fold; shading on under side of fore wing and up side of hind wing light brown; wings more acute.....3. *clemensia*
3. No costal fold; hind wing shaded with gray, or pure white; fore wi with costa more arched and apex blunter.....4. *pallora*

I. *Male with a short costal fold, hardly reaching base of wing, and bearing a fo shaped tuft of long scales at middle, extending down over costal part of wi*

1. **T. afflictana** Walker. Pale gray, with base, an oblique fascia across midd a costo-apical triangle and a vague shade on outer margin darker; defined wi fine black striæ. Antemedial line angled at middle. Ground more or less d tinctly reticulate. Hind wing slightly duller gray. 18–22 mm. (*fuscolineana* May. Caterpillar on fir.

Newfoundland to Texas and California. New York: Ithaca, Albany, N Windsor.

2. **T. packardiana** Fernald. Fifth report United States Entomological Co mission (Forest Insects) 849. A black, gray, and white species from fir, whi I have not seen.

3. **T. clemensiana** Fernald. Fore wing long and narrow, nearly three times as lo as wide, and falcate in the female. Fore wing plain straw yellow, in varie **nervosana** Kearfott lightly veined with gray. Hind wing and under side of fo wing white, shaded, at least in male, with pale brown, leaving the costa whi 16–20 mm.

Common in May and June, and in August. Female somewhat narrower-wing than *pallorana*.

Generally distributed. New York: Peru, Newport, Lewiston, Honeoye Fal Rock City (Cattaraugus County), Potter Swamp (Yates County), Ithaca, B Indian Valley, Utica, Albany, New Windsor, Staten Island, Brooklyn. Varie *nervosana* Kearfott occurs at Peru and Ithaca.

II. *No costal fold.*

4. **T. pallorana** Robinson. Similar to *T. clemensiana*, but without costal fol on the average little larger, especially in female (30 mm.); hind wing a litt grayer in male, normally white in female; fore wing a little duller, not vein with gray. 20 to 25 or 30 mm. (Male *lata*, female *pallorana* Robinson.)

June and July. Larva on cherry, Silphium, and Verbena.

Massachusetts to Illinois, Missouri, and Texas. New York: Newport, Honeo Falls, Batavia, Potter Swamp (Yates County), Ithaca, Albany.

5. **T. alleniana** Fernald. Light yellow-brown, crisply reticulate with brow with a vague darker oblique fascia and a costo-apical patch, the fascia tending be lost in the middle, and both clean-cut only on the costa; sometimes suffused wi dull gray. 20–25 mm. (*Cacœcia*).

July. Larva a general feeder.

This species is superficially an Archips, but the palpi are markedly beaklik and the costal fold is completely absent.

Maine to Manitoba. New York: Peru, Newcomb.

44. *ARCHIPS* Hübner (Tentamen)

(*Cacœcia* Hübner; *Ptycholoma* Stephens; *Tortrix*, in part, etc.)

imilar to Tortrix, with the same venation (fig. 238) and vestiture; palpi close-ed except for a little loose hair near the tip of the second joint; second joint ngly upcurved (fig. 242) and concave on upper side; costal fold almost always sent, but in several species reduced to a tiny pointed flap which does not over; absent in *conflictana*, extremely rudimentary in *purpurana*. R_4 and R_5 uently short-stalked in *C. rileyana*, especially in the male.

Key to the species

1. Ground color white; marked with black.....15. *dissitana*.
1. Ground color not white.
2. Streaked longitudinally with blackish between veins.....13. *striana*.
2. Transversely marked or spotted.
3. A triangular pure white costal patch.....14. *persicana*.
3. No pure white markings.
4. Costa cream colored, except for a patch toward apex..23. *melaleucana*.
4. Whole wing cream colored, with faint ochre reticulations and markings .....19. *negundana*.
4. Ground dark, with a quadrate or triangular cream patch beyond middle of costa, and usually other patches.
5. Ground yellow-brown, of a mixture of contrasting brown, yellow, and cream scales .....16. *argyrospila*.
5. Ground gray-brown in broad shades.....17. *mortuana*.
5. Ground light red to pinkish gray, the costal spot triangular. 18. *semiferana*.
4. No cream color on fore wing; the quadrate patch beyond middle absent, or of the ochre or darker ground color, and not contrasting with the general surface of the wing.
5. Hind wing yellow or orange, at least on costal half.
6. Fore wing with sharply defined red-brown dots.....12. *rileyana*.
6. Fore wing with irregular powdery red-brown patches, or all rusty orange. .....11. *cerasivorana*.
6. Fore wing with the oblique fascia bounded by fine dark striæ, at least at costa.....7. *rosaceana*.
6. Fore wing with a narrower blurred dark fascia....2. *obsoletana*.
5. Hind wing not largely yellow or orange.
6. Males (frenulum simple).
7. Costal fold absent or represented by a slight roughness and curvature of the costa.
8. Hind wing fuscous, concolorous with fore wing. 1. *conflictana*.
8. Hind wing pale.
9. Fore wing reddish, with a distinct outwardly oblique antemedial line; median band complete, contrasting; subterminal band continued by a shade and stria on its inner side to anal angle.....4. *parallela*.
9. Fore wing reddish, with a dark spot at middle of costa and other faint markings, or immaculate.....2. *obsoletana*.
9. Fore wing with distinct olivaceous tint, the median band above cell, and subterminal spot distinct; large. 3. *zapulata*.

7. Costal fold represented by a small point ending in a tuft of hair-scales, folded back on wing.
8. Hind wing dark gray, median fascia represented by a large dark shade below.....6. *fractivittana.*
8. Hind wing light on costal half.
9. Striation in antemedial region distinct, nearly transverse; fore wing light wood-brown.....7. *rosaceana.*
9. Striation strongly excurved or angulate on the fold, often lost in the dark purplish ground color; ground not usually wood-brown.....5. *purpurana.*
7. Costal fold slender, extending nearly to middle of wing and fringed below with long hair-scales.
8. Ground purple, banded contrastingly with chocolate brown. 9. *infumatana.*
8. Ground dark olive-brown, the median fascia usually clean-cut, but not contrasting.....8. *rosana.*
8. Ground yellow-brown, with a dark gray patch in fork of **Cu.** 10. *fervidana.*
7. Costal fold broad and clean-cut.
8. Wings evenly mottled in two shades of rusty orange. 20. *georgiana.*
8. Fore wing with a dark bar from below middle of cell to basal angle.
9. Gray.....21. *grisea.*
9. Brown.....22. *magnoliana.*

6. Females (frenulum of three bristles).
7. Ground color gray, with clean-cut markings.....21. *grisea.*
7. Both wings dull fuscous, marks blurred.....1. *conflictana.*
7. Ground brown, varying in shade.
8. Hind wing gray (except costa).
9. Fore wing with an oblique dark bar below middle of cell to basal angle.....22. *magnoliana.*
9. No oblique bar running to basal angle.
10. Fore wing purple with brown fasciæ....9. *infumatana.*
10. Fore wing olivaceous, with clean-cut but not contrasting fascia.....8. *rosana.*
10. Fore wing yellow-brown, with patch in fork of **Cu.** 10. *fervidana.*
10. Fore wing evenly mottled in two shades of rusty orange. 20. *georgiana.*
8. Hind wing with dorsal half shaded with light gray.
9. Costa nearly straight.....6. *fractivittana.*
9. Costa deeply sinuous.....5. *purpurana.*
8. Hind wing pale.....2. *obsoletana,* 3. *zapulata,* 4. *parallela.*

I. *No costal fold.*

1. **A. conflictana** Walker. Dull light gray, velvety looking; all the marks, even the reticulation, a little diffuse; an obscure darker shade from costa just before middle, reaching inner margin two-thirds way out, with a paler patch following it; less oblique than usual. Indications of a postmedial patch and curved subterminal shade. Hind wing concolorous. 25–35 mm.

June and July.

Labrador to Alaska, south to New York and Utah. New York: Peru, Batavia, Ithaca; Woodhaven, Long Island.

2. **A. obsoletana** Walker. Fore wing in male with costa convex except near apex, not sinuous; outer margin convex; very pale fawn color, striate with darker; the

fasciæ represented by two darker fawn patches on costa. Hind wing dirty white. Female similar, the hind wing usually yellow, and fore wing almost immaculate. 20 mm. (*vesperana* Clemens, *sanbornana* Robinson, female *transiturana* Walker).

A. obsoletana has a tendency for the inner half of the hind wing to darken, especially in the female, as in *rosaceana*, but it may be distinguished by its lack of clearly defined fasciæ. The next two species are practically the same in structure and may not be distinct.

The larva is a general feeder and is sometimes injurious to strawberries. Moth common in August, rarer in July.

General in distribution. New York: Peru, Essex County, Ithaca, Albany, Putnam County, Katonah, Clove Valley, Staten Island.

3. **A. zapulata** Robinson. Larger; generally a little lighter and less yellow; fascia clearly defined on the costa, and represented by a slight vague patch in fold. Hind wing entirely cream color in both sexes. 25 mm.

This is probably merely the western form of *A. obsoletana*. Many eastern specimens show the same color and pattern but they are never quite as large.

Illinois and west.

4. **A. parallela** Robinson. Costa of fore wing distinctly sinuous, as well as outer margin, forming a small lobe at apex. Fore wing dull reddish brown, the fascia contrasting blackish, but not always sharply defined; base also dark, or indicated by a dark antemedial fascia; postmedial spot strong. Hind wing with more or less gray, never yellow. 20–25 mm. (**H. 48**:31.)

Superficially, very like forms of *purpurana*, but distinguishable in male by the lack of costal fold.

Apparently general in distribution. New York: West Albany; Clove Valley, Staten Island.

II. *Costal edge folded over in a small lobe, the fold not reaching the base, and ending in a more or less marked tuft of hair-scales.*

5. **A. purpurana** Clemens. Costal fold with shorter hair-scales than in *A. rosaceana*. Varying from light dull wood-brown to umber brown, with a slight purple iridescence in male; frequently leaving the outer margin contrastingly light; less distinctly purple than *infumatana*; costa and outer margin more or less sinuous, extremely variable; fore wing with well-marked reticulation in pale phases, the brown antemedial line fine, and strongly excurved or bent at almost a right angle in the fold, the upper part parallel with the fascia, which is usually well defined and contrastingly dark except in the cell, where it is represented by the dark outlines only; in very pale or very dark specimens, the fascia is obsolete. Subterminal patch not defined below, lying at the foot of the costal notch. Hind wing gray on dorsal half, cream above. Female similar, rarely so dark as to obscure the pattern; with the median band marked by strong striæ but only a little darker than the ground; costa outwardly and outer margin above very strongly concave, cutting off a round apical lobe. 23–30 mm. (*gurgitana* Robinson; *lintneriana* Grote).

Larva on geranium.

New Hampshire to latitude of New Jersey. New York: Fentons (Lewis County), Ithaca, Schoharie, vicinity of Albany.

6. **A. fractivittana** Clemens. Dull olivaceous, paler on costal half; fascia fairly well defined on costa, interrupted by a pale shade on cell; enlarged into a large patch below; postmedial costal patch small, distinct, and often with an antemedial costal patch besides. Reticulation weak, often absent in male; hind wing gray with pale costa, in male; in female with costal half pale. 18–28 mm. (*fumosa* Robinson.)

June.

Western Pennsylvania. New York: Ithaca, Trenton Falls.

7. **A. rosaceana** Harris. Costa and outer margin somewhat sinuous, but less s in male than in male of *A. purpurana,* and strikingly less so in female, the sexe being nearly alike in wing form. Strongly reticulate with brown; median fasci clean-cut but not strongly contrasting, postmedian patch likewise; basal striati transverse, or rarely, parallel to fascia, and not strongly curved. Hind wing c male cream, somewhat shaded toward the inner margin with gray; in the femal yellowish to bright orange, with the dorsal half contrasting gray. 20–28 mm (**H. 48**:32.)

Common. Larva general on trees and shrubs; rarely, even on clover; sometime injurious to apple.

General. New York: Common everywhere.

A. hewittana Busck is unknown to me, and from the description I cannot di tinguish it from *A. rosaceana.* It was described from Nova Scotia.

III. *Fold narrow, gradually fading out near middle of wing; fringed more or les with hair-scales below; generally forming a distinct flat tuft a third way ou on costa.*

8. **A. rosana** Linnæus. Wings slightly sinuous before apex; sexes similar. Du brown, with slight greenish gloss; hind wing mouse gray, not contrasting; fasci not strongly oblique, well marked, sharply defined on inner side; postmedial patc continued by a strong subterminal stria toward anal angle. Striation sparse 15–22 mm.

Not very common. Larva a general feeder.

Massachusetts to Missouri and Europe. New York: Thousand Islands, Albany West Farms.

9. **A. infumatana** Zeller. Purple (as a strong iridescence on a blackish under color): base, a broad, well-defined fascia, and a subterminal streak reaching nearl to anal angle, contrasting dark chocolate brown; all often defined with ligh yellow brown; wing form of male like that of *A. rosana;* the female with mor strongly sinuous costa. **18–25 mm.**

July. Larva on hickory.

Connecticut to Missouri and Wisconsin.

10. **A. fervidana** Clemens. Brown on basal half, gray on outer half, with heav and sparse ochre-yellow striæ, partly edged with cream, and, especially outward centered with blackish, giving a general yellow-brown effect; dark patches on cost at middle and three-fourths way to apex, with yellow between them; a curved blackish patch below outer end of cell, defined on inner side. Hind wing gray 15–22 mm. (*paludana* Robinson.)

July and August. Larva on oak; somewhat social; in small webs full of frass

Generally distributed. New York: Ithaca.

11. **A. cerasivorana** Fitch. Fore wing dull orange and when fresh, with purpl iridescence; hind wing immaculate bright orange. Male irregularly spotted and speckled with dark red-brown, gathering into patches at middle and three-fourth way out on costa, and below end of cell; female with more reduced speckling, o nearly immaculate. 18–25 mm. (**H. 48**:21.)

Larva social; in a large nest of mixed silk and frass; on wild cherry; pupatin in the nest. Imago in July.

Generally distributed. New York: Peru, Essex County, Fentons (Lewis County) Honeoye Falls, Ithaca, Big Indian Valley, Schenectady, Albany, New Windsor.

12. **A. rileyana** Grote. R_4 and R_5 stalked in male and sometimes in female. Dull orange, tending to be suffused somewhat with grayish brown; with small deep orange-red spots; two larger spots on costa; a spot a third way out, and a pai two-thirds way out, on fold; and a broken series of small spots near outer margin often with part of the spots wanting, or with additional spots at a third and two

hirds way out, forming short series. Hind wing light orange. 20–28 mm. (*Homona* Meyrick.)

June. Larva social, on horse-chestnut in early June; also reported from hickory, valnut, snowberry, and Vernonia.

Pennsylvania; North Carolina; Washington.

13. **A. striana** Fernald. Umber-brown, with a broad luteous ray over cell from base to apex; a similar streak below A to three-fourths way out on inner margin; and broad, partly confluent streak on veins toward outer margin; blackish streaks between veins. Hind wing gray. 25 mm.

Rare.

Quebec; Ontario; New Hampshire; Manitoba.

IV. *Fold not reaching middle of costa; rather thick, and, on the outer half, fringed heavily with hair-scales.*

14. **A. persicana** Fitch. Basal half of fore wing orange-ochre; outer half bright brown, with a silver-white costal triangle, concave on the outer side. Margin sharply defined, contrasting pale yellow with a couple of brown striæ. 20 mm. (*blandana* Clemens).

June. Larva on various plants.

Maine to Manitoba; a race with a smaller silver spot, in British Columbia. New York: Peru, North Elba, Fentons (Lewis County), Newport, Rock City (Cattaraugus County), Ithaca, Liberty, DeBruce, Big Indian Valley, Ballston, Schenectady.

V. *Fold well formed, but only one-fifth of the length of the wing, rough-scaled on the edge.*

15. **A. dissitana** Grote. White, with irregular angular black patches, the two largest forming a fascia from costa to before anal angle, interrupted over the cell. 20–25 mm.

July. Apparently rare. Larva probably on conifers.

Maine to Ohio. New York: Uphill Brook, Mt. Marcy, Ilion, Buffalo, Jamestown, Ithaca.

16. **A. argyrospila** Walker. Irregularly mottled with a mixture of cream, straw yellow, red-brown, and often black-brown, scales, leaving a series of cream-colored quadrate patches on costa, the one just beyond the middle being the largest and most constant. Hind wing mouse gray. 20 mm. (*furvana* Robinson, *signatana* Packard). (**H 48**:34.)

Larva a general feeder, and often injurious to apples, being the commonest of the many apple leaf-rollers. Moth in June, rarely with a few stragglers in July.

Very common and generally distributed. New York: Common and general.

17. **A. mortuana** Kearfott. Brownish gray, irregularly mottled with cream and darker gray or blackish; with two contrasting quadrate cream-white spots on middle of costa, and sometimes considerable cream striation on outer margin. 18 mm.

June. Possibly a variety of *A. argyrospila*, which is markedly variable.

Western Pennsylvania to Wisconsin. New York: Ithaca.

18. **A. semiferana** Walker. Light Indian red, more or less shaded with gray; somewhat mottled with straw yellow, especially on basal fourth; costa with straw-yellow patches at one-fourth way out at middle, and before apex, the middle one neat and triangular, and the other two irregular and broken up into spots. Female generally paler. Very pale specimens shading into cream color on the inner margin and apparently intergrading with *A. negundana*. Hind wing concolorous. 20 mm.

Common, the larva a general feeder, but most common on maple and Negundo.

Generally distributed. New York: Newport, Ithaca, Albany.

19. **A. negundana** Dyar. Light cream-yellow with a slight pinkish tinge, fain reticulated with ochreous; the cream pattern of *A. semiferana* more or l traceable.

The larva occurs with *A. semiferana* on Negundo and maple.

New Jersey; Utah; Manitoba; Florida; etc.

20. **A. georgiana** Walker, a bright orange species, striate with red-brown, w cream-colored areas between the striations, especially toward the costa, and da gray hind wing; has been taken at Lakehurst and Whitesbog, New Jersey, in Ju

VI. *Fold reaching practically to middle of wing, broad, thick, and scaled alo the edge.*

21. **A. grisea** Robinson. Light ash gray, a little powdery. A contrasting blac ish streak from middle of lower side of cell to inner margin near base. A blacki patch in outer part of cell, extended as a yellow-brown shade toward anal angl a contrasting blackish patch on costa at three-fourths way out and a dark brow oblique subterminal lunule. Hind wing gray. Female similar, larger, the dors markings all obsolete, or barely traceable, and with an additional short obliq blackish bar from costa at two-fifths way out. ♂ 18 mm., ♀ 23 mm. (♂ *braunia* Kearfott).

Larva on oak and Rudbeckia.

Maine to Missouri.

22. **A. magnoliana** Fernald. Typically, fawn colored, with purple reflections disc; varying to dark purple-brown; the markings much as in *A. grisea*, cinnamo brown, faintly outlined with white; outer part of wing dull whitish, the obliq subterminal streak smoky brown. Hind wing pale fuscous. 20 mm.

Larva on *Magnolia acuminata*.

New York: Rock City, Ithaca.

VII. *Fold thick and broad on basal half, as in group V, but narrowly extended middle of wing.*

23. **A. melaleucana** Walker. Costal third or more cream white, cut by th blackish costal fold and a vague postmedial patch. Dorsal half of the base gra mixed with yellow-brown, followed by a very large rounded patch of mixed black brown and purple-gray, which extends nearly to anal angle, the dark marks a edged with yellow-brown. Outer margin usually cream, sometimes suffused wit dark gray, especially in the female. Hind wing whitish, shaded with gray. I the darkest specimens the fore wing almost all suffused with gray, leaving onl the middle of the costa cream color. 20 mm.

May and June. Larva on Trillium and Polygonatum.

Very common south to New Jersey. New York: Peru, North Elba, Batavia Vandalia, Rock City (Cattaraugus County), Portage, Ithaca, Big Indian Valley Schuyler, New Windsor, Staten Island.

45. *PANDEMIS* Hübner

Appearance and venation as in Archips. Palpi triangular, beak-like; thora smooth; male antennæ with a few joints near base of shaft partially fused an notched on inner side.

1. **P. limitana** Robinson. Pale reddish brown, with some fine darker and grayer brown striations. Three fine, rather contrasting pale lines from before middle o costa, running to one-third and two-thirds way out on inner margin, and to ana angle; the base and the space between the two outer lines perceptibly darker. A semicircular or somewhat pear-shaped subterminal costal patch, which also has a fine pale outline. Hind wing paler, with some light reddish brown striation toward apex, becoming gray toward inner margin. 20 mm.

une; August. Larva a general feeder, especially on trees.
enerally distributed. New York: Ithaca, Schenectady.
P. lamprosana Robinson. Slightly yellower, the darker base, medial fascia, spot near apex more contrastingly dark, and edged with dark instead of pale. d wing of male all dirty white.
arer than *P. limitana*. June to August.
uebec to Pennsylvania. New York: Ithaca, Schenectady, Albany, Staten Island.
. albaniana Walker, described from Hudson Bay, is unknown to me, and I not distinguish it, by the description, from *P. lamprosana*.
. P. canadana Kearfott. Darker reddish brown, the three lines strongly waved, ecially the inner two, which are practically straight in the other two species; lines themselves not notably darker or paler, but serving as the boundaries of contrasting, fuscous gray base, median fascia, and apical patch. Hind wing ost wholly gray.
uly and August.
uebec and Manitoba.

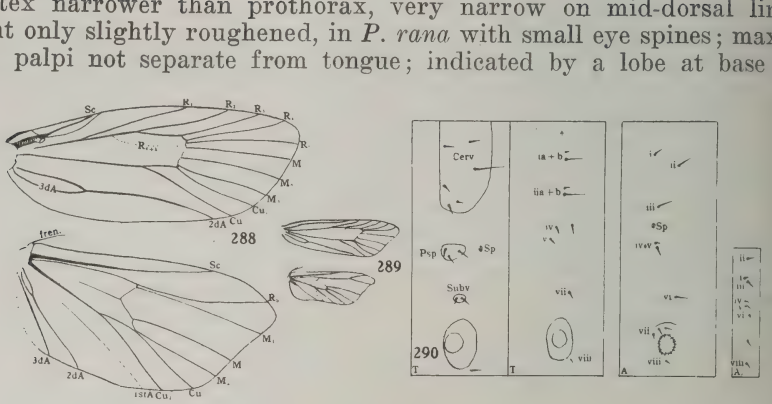
Family 29. PHALONIIDÆ

(*Conchylidæ; Tortricidæ,* in part)

Small, rarely medium-sized, moths. Head somewhat roughly scaled. elli normally small, antennæ as in Tortricidæ; tongue weak or absent, en strongest about like the weakest tongues in the Tortricidæ. Palpi ying from moderate to long, porrect, beak-like; rough-scaled, the rd segment long and porrect. Body small, scaled; thorax usually h a slight posterior tuft. Under side scaled. Legs scaled, the hind iæ with some rough scales or hair. Wings (figs. 288, 289) most en rather long and narrow; rounded; usually bent down at the ex. Usually with a distinct accessory cell, of Tineid type, and the se of **M**, when traceable, running obliquely across the cell as in the rtricidæ. $\mathbf{R}_5$ running either to costa or outer margin, stalked or free, t free in our species; the other veins all free. $\mathbf{Cu}_2$ from three-fourths y out on cell or beyond; **1st A** absent (distinguishing the family m the few Tortricidæ in which $\mathbf{Cu}_2$ arises about three-fourths way t on the cell), **2d A** with a large basal fork, with both branches ually strong. Hind wing trapezoidal; **Sc** normal, connected with by a weak vein before middle of cell; **R** and $\mathbf{M}_1$ approximate or alked; $\mathbf{M}_2$ free, rather close to $\mathbf{M}_3$, which is separate or stalked with $(\mathbf{t}_1$; $\mathbf{Cu}_2$ arising farther from end of cell than in fore wing; **1st A** eak or absent, **2d A** with a rather strong basal fork, **3d A** very weak absent.

Larvæ (fig. 290), so far as known, borers, or feeding in seeds, usually herbaceous plants. Prothorax with seta *delta* (subdorsal posterior) low and in front of *beta* (addorsal posterior) and close to it; i and v of abdomen in a nearly horizontal line; seventh segment of bdomen with vii of a single seta; prolegs poorly developed, with niordinal hooks. Pupa of Phalonia approximating the Cossid type.

Vertex narrower than prothorax, very narrow on mid-dorsal line; front only slightly roughened, in *P. rana* with small eye spines; maxillary palpi not separate from tongue; indicated by a lobe at base of



FIGS. 288–290. PHALONIIDÆ

288, *Hysterosia terminana,* venation and costal fold; **289,** *Phalonia dubitana,* venation; **290,** *Phalonia posterana* (Europe), seta map of larva

tongue; labial palpi fully exposed but shorter than the tongue; tongue shorter than the fore legs. Antennæ long, not quite reaching to the end of the wings. Abdomen with two rows of spines on each segment from the first or second to the sixth or seventh; with single rows on the eighth to the tenth or the seventh and eighth segments; the anterior row on each segment heavier. Tenth segment without cremaster; obliquely truncate; sometimes with a circle of setæ around the edge; with the addorsal, subdorsal, and lateral pairs stronger, but knobbed rather than hooked; sometimes with a few weak setæ only; the edge also with angulations or short spines, of which a subdorsal pair is most prominent, or is alone present. Early stages studied mainly in Phalonia.

In *Hysterosia birdana* the pupa is rougher, rugose, and with the posterior portions of the movable segments shagreened with rough knobs. There are two rows of spines on the second to sixth segments of the abdomen inclusive, and one only on the seventh and eighth segments. The circle of spines at the end of the body is composed of three pairs on the supra-anal plate, and four ventral pairs. The setiferous tubercles are somewhat elevated. The front has an even-edged ventro-apical plate curving up at the ends and down at the base of the antennæ, and no eye spines. The maxillary palpi are more definitely indicated than in Phalonia.

This family is closely related to the Tortricidæ, but with definite points of distinction in both larva and imago.

Key to genera: imago

1. Fore wing with R_5 running to costa, or, rarely, to apex.
2. Hind wing with M_3 and Cu_1 separate; wings nearly smooth (fig. 289). **4. Phalonia.**
2. Hind wing with M_3 and Cu_1 connate or stalked; wings with scale-tufts. **3. Commophila.**

1. Fore wing with R_5 running to outer margin.
2. Hind wing with **R** and M_1 stalked ..... 2. **Pharmacis.**
2. Hind wing with **R** and M_1 approximate (fig. 288) ..... 1. **Hysterosia.**

1. *HYSTEROSIA* Stephens)

(*Idiographis* Lederer)

Rather large, ample-winged moths with long beaklike palpi. Colors dull browns or grays; antemedial line running up obliquely from basal angle to cell at one-fourth way out, then obscure, or curving in to costa; postmedial line running obliquely across apex, with a dark shade beyond and a pale shade before it. General wing surface obscurely mottled; hind wing light, distinctly reticulate.

Key to the species

1. Postmedial band contrasting, clearly defined, and followed by a blackish shade; antemedial line less distinct.
2. Head, except close to eyes, contrasting pale luteous ..... 2. *terminana.*
2. Head concolorous dark smoky gray; fore wing with slight purplish tint. **1. *birdana.***

1. Postmedial line inconspicuous or absent; if present, diffuse; antemedial line often distinct.
2. Head luteous, fore wing shaded or dusted with yellowish, especially in fold.
3. Smaller; base of fore wing dull clay-color; ground gray-brown. *5. baracana.*
3. Larger; base of fore wing bright ochre, followed by a yellow-brown shade ..... 6. *cartwrightiana.*
2. Head concolorous; fore wing all dark.
3. With a clearly defined, but not pale-edged, dark apical patch .... 3. *riscana.*
3. Apex concolorous ..... 4. *modestana.*

1. **H. birdana** Busck. Dark fuscous gray, slightly purple-iridescent, dusted with black-brown. Head and palpi concolorous. Antemedial band fairly defined in inner side, showing as a dark shade not reaching costa. Postmedial band slightly concave outward, from costa at three-fourths way to apex toward outer margin just above anal angle, but not quite reaching margin; formed of a fine pale line followed by a heavy blackish shade. A fine black discal dot in a blackish shade, the dot partly defined with pale, not conspicuous. Hind wing much paler, reticulate with fuscous. Fore wing below dark, with reticulate costal edge; hind wing light, crisply reticulate, with a bar in outer part of discal fold. 22–27 mm.

August. Larva boring in roots of Helianthus, accompanying *Papaipema nelita.*

New York to Delaware, especially along the coast. New York: Ithaca, Rye.

2. **H. terminana** Busck. Duller lighter fuscous, without purple tint; the markings about as in *H. birdana*, but head, except above eyes, contrastingly pale. Beneath about as in *H. birdana*, but without the blackish bar in the discal fold, a character which is perhaps more distinctive than the color of the head. 18–22 mm. (*merrickana* Kearfott).

Apparently general in distribution; usually reported as *inopiana* Haworth, which does not occur in the New World.

New York: Ithaca, Slaterville, Catskills (Pearsall).

3. **H. riscana** Kearfott. Ash gray, dusted with fuscous; antemedial band c spicuous, edged above with whitish, running from basal angle to upper side cell, at one-third way out, fading out to costa. A distinct darker apical pat its inner boundary running as in *H. birdana*, but not at all defined with pale blackish. Hind wing hardly paler, reticulate; head and thorax hardly pal Under side with costal edge of fore wing, and whole hind wing whitish, sharp reticulate with fuscous. 16 mm.

July. Types only seen.

Glenburn, Pennsylvania.

4. **H. modestana** Busck. Dull fuscous, mottled, but without any clean-cut powd ing or markings, the two bands sometimes indicated by blurred dark shades. Disc dot black, in a pale spot. Hind wing grayish fuscous, not reticulate above, a obscurely so below. 16 mm.

Maine; Iowa. New York: Ithaca.

5. **H. baracana** Busck. Fore wing a crisp mixture of fuscous, blue-gray, a luteous or ochre-yellow, with the ochre often predominant in the fold and abo the antemedial shade, where there is usually a yellowish streak. Postmedial ba indicated by a gathering of the dark fuscous powdering, not sharply defined. Disc dot distinct, black. Hind wing pale, not distinctly reticulate. 12–16 m (*tiscana* Kearfott).

July and August.

Maine to Pennsylvania and Manitoba. New York: Ithaca.

6. **H. cartwrightiana** Kearfott. Wood-brown, shaded with bright tawny or deep yellow-brown beyond the antemedial band. Basal area bright ochre, shaded wit dark brown along costa, antemedial shade blackish, conspicuous; postmedial vague darker area merely. 18–21 mm.

July.

New York to Manitoba. New York: Slaterville, Ithaca.

2. *PHARMACIS* Hübner

(*Euxanthis* Hübner)

Like Phalonia, except for the termination of **R** in the outer margin, and th connate or stalked M_2 and Cu_1 of the hind wing; superficially exactly like Phaloni

Key to the species

1. Dull ochreous to gray.
   2. Antemedial fascia complete, reaching inner margin ..... 2. *sartan*
   2. Antemedial fascia stopping at **A** ..... 1. *bimaculan*
1. Bright lemon yellow ..... 3. *vitellinan*

1. **P. bimaculana** Robinson. Varying from light dull ochreous to dull grayis brown. Two thick dark brown crescents, of equal size, one running from belo middle of costa to vein **A** at one-fourth way out, the other from below ape to lower angle of cell; both with the convex side down, and placed in paler area Hind wing light brown to mouse gray. 10–14 mm.

August and September.

Southern States north to St. Louis, Missouri.

2. **P. sartana** Hübner. Similar to *P. bimaculana*. Antemedial fascia runnin from middle of costa to inner margin at one-third way out, about twice as wid at inner margin as at costa, with irregularly excurved outer side.

August. I have seen no northern specimens.

Pennsylvania (type locality); Florida; Louisiana.

P. vitellinana Zeller. Lemon yellow, with transverse silver striæ or series
ots; ground sometimes shaded with red-brown, or with the silver markings
ning red-brown bands; when most developed, with a brown oblique bar to
basal angle, one at right angles to the first from the middle of the costa
ie inner margin at two-thirds way to the apex, and a couple of mixed brown
silver streaks across the apex. Hind wing dark gray, contrasting. 10–14 mm.
ne. Sometimes very common locally.
w York to Illinois and north. New York: Peru, Black Brook (Clinton
ty).

3. *COMMOPHILA* Hübner

(*Phtheochroa,* in part)

milar to Hysterosia, but wings narrower, heavily scale-tufted; R_5 running to
. No costal fold (normally present in Hysterosia).
C. contrastana Kearfott. M_3 and Cu_1 of hind wing connate. Head and fore
; white; thorax and base and dorsal half of fore wing two-thirds way to
, contrasting, black, mottled with blue-gray; with a couple of black dots.
l wing pale brown, with white fringe. 20 mm.
d of May to June.
nnecticut; western Pennsylvania.
C. bana Kearfott. M_3 and Cu_1 separate. Dark wood-brown, considerably
d with black; the scaling as a whole rough, with larger rounded tufts at end
ell and before and beyond middle of A. Tufts more shining, slightly pinkish,
in most lights paler than the ground color. Hind wing a little duller and
r, with pale fringe. 13 mm. (*Phalonia* Kearfott).
icago, Illinois; in September. (The type has the date "June" corrected to
ptember," the description says "June.") Woods Hole, Massachusetts; in
ust.

4. *PHALONIA* Hübner

(*Conchylis* Treitschke; with *Dapsilia, Eupœcilia,* etc.)

alpi beaklike but moderate, shorter than in Hysterosia and Commophila. Fore
g rounded, rather narrow, with all veins separate and R_5 running to costa or
x; hind wing with R and M_1 stalked, M_3 and Cu_1 well separated.
he species of Phalonia are often strongly marked in contrasting colors, some-
es with silver, and are among the most brilliant of the Tortricids; but a few
dull-colored. The genus is already large, but probably a good many species
yet to be discovered, as in the other larger boring genera.
halonia listerana Kearfott is a Cnephasia, *P. vitellinana* is a Pharmacis.

Key to the species

1. Fore wing with a sharply defined, nearly terminal darker band, more or less distinctly pale-edged; the median fascia rarely silver-edged, and in that case broken into spots.
2. Yellow, with four red bands; the two outer ones joining toward the inner margin ..... 1. *rutilana.*
2. Without red bands.
3. Base solid dark, its outer boundary even, nearly straight, and only a little inwardly oblique to inner margin ..... 21. *louisiana.*

3. An oblique antemedial fascia resting on basal angle, or dark base with angulate outer boundary.
4. Apex sharp, forming an angle of over 60 degrees; ground, especially of antemedial area, normally shaded with yellow-brown, never dark. 11. *obliquana*.
4. Apex blunt, hardly forming an angle of 60 degrees, even in female.
5. Antemedial pale area toward dorsum evenly pale cream; markings also very pale ..... 10. *promptana*.
5. Antemedial area dusted with fuscous or shaded with brown. 12. *angulatana*, 13. *bomonana*.

1. With dark base, a median band, rarely broken, and subterminal darker fascia, all distinctly edged with silver (the silver very faint in *P. labeculana*).
2. Ground of thorax and fore wing white ..... 3. *argentilimitana*.
2. Ground dirty white dusted with gray ..... 2. *labeculana*.

1. With a fine contrasting dark subterminal line, parallel to the strongly oblique outer margin.
2. Expanse over 15 mm.; darker ..... 8. *biscana*.
2. Expanse under 15 mm.; paler ..... variety *giscana*.

1. Terminal, or subterminal, dark band absent, or represented by scattered scales or a vague shade; markings rarely defined with silver.
2. A triangular or rounded dorsal postmedial patch, not reaching the cell; antemedial oblique fascia running up from basal angle to cell.
3. Ground cream ..... 9. *dorsimaculana*.
3. Ground wood-brown ..... 4. *interruptofasciata*.
3. Ground dark gray ..... 14. *rana*.
2. An oblique antemedial fascia, extending up to cell, starting from inner margin at a point well beyond the basal angle, the upper part of the cell wholly of the ground color.
3. Ground pale gray; fascia extending into cell.
4. No costal spot opposite fascia; fascia mottled with yellow. 40. *temerana* (*cincinnatana*).
4. Costal spot present; dark markings wholly gray ..... 47. *lavana*.
3. Ground light yellow; fascia not entering cell.
4. A small costal spot opposite fascia ..... 15. *smeathmanniana*.
4. No costal spot; a series of subequal costal streaks ..... 16. *scissana*.
2. A dark median fascia with clearly defined edge, reaching from costa to inner margin, sometimes interrupted part of the width of the cell.
3. Base and outer third of wing at least suffused with bright pink, median fascia brown ..... 28. *aurorana*.
3. No pink iridescence at base; sometimes a little outwardly in species with a blackish fascia.
4. Ground yellow; fascia H-shaped, enclosing squarish costal and dorsal patches; the costal ends of the fascia cream-colored, paler than the ground, but shading into the brown dorsal part ..... 7. *sublepidana*.
4. Fascia cut by a pale spot; bar in cell nearly or completely interrupting it.
5. This spot yellow ..... 17. *fuscostrigana*.
5. This spot pale gray ..... 18. *deutschiana*.
4. Fascia complete, simple, and wholly dark.
5. An oblique antemedial fascia resting on the basal angle; median fascia yellow-brown, followed by an oblique black streak. 22. *romonana*.
5. No oblique antemedial fascia; median fascia, when yellow-brown, not defined with black.
6. Median fascia brown, edged with blackish below; base yellow-brown ..... 6. *lepidana*.

7. Fascia wholly yellow-brown, not very much darker than ground. 21. *louisiana.*

7. Fascia dark brown or heavily shaded with blackish.
8. Basal and outer thirds bright yellow; fascia brown.
9. Fascia black below the cell; outer third darker than base. 43. *gunniana.*
9. Fascia all brownish; basal and outer thirds concolorous. 23. *hospes.*
8. Base cream white; outer part dull ochre, at least on terminal margin and fringe, more or less distinctly shaded with pink. 29. *hollandana,* 30. *bunteana.*
8. Ground all luteous; a very small species with a distinct dark subterminal bar across apex.....42. *maiana.*
8. Base straw yellow, except along costal edge; outer part gray and smooth looking to naked eye; without distinct subterminal bar.
9. Apical third yellowish, darkening to red-brown; hind wing white .....25. *plummeriana.*
9. Apical third olivaceous; hind wing light gray. 24. *straminoides.*
8. Base with white ground but mottled with luteous and gray; outer part heavily mottled with gray.....47. *lavana.*

2. Fore wing with confused markings; with a more or less distinct diffuse median fascia; outer part of wing darker than base.
3. Base pale gray, shading through chocolate brown to the pink apex. 27. *viscana.*
3. Base and outer part more or less suffused with pink.....28. *aurorana.*
3. Outer part of wing not suffused with pink.
4. Fore wing heavily tufted, the tufts whitish on a brown ground. (*Commophila bana*).
4. Fore wing smooth, or with small hardly raised tufts.
5. Basal third or half of fore wing whitish, more or less contrasting.
6. Base broadly ash gray to a fourth way out on costa, leaving a pale antemedial band.
7. Antemedial band partly white; markings gray....41. *leguminana.*
7. Markings partly yellow-brown, and slightly brassy..2. *labeculana.*
6. Paler basal third extending almost to base of wing, at least in cell.
7. Ground of medial and outer areas light olivaceous gray, dusted and outwardly shaded with black.....46. *marloffiana.*
7. Ground of medial area brown (or light yellow in *lavana.*)
8. Outer part with light black striæ only.....47. *lavana.*
8. Subterminal region with a large black patch.
9. Black patch extending from just beyond cell almost to outer margin, and from below costa two-thirds-way to anal angle .....45. *zoxcana,* 46. *toxcana.*
9. Black patch about half as large, and mixed with brown. 44. *hoffmanana.*
8. Subterminal region with a large brown patch, concolorous with the paler scaling of the median fascia; markings all very indistinct and powdery.....40. *temerana.*
5. Base of wing concolorous.
6. Ground mottled, yellow-brown.....35. *elderana.*
6. Ground wood-brown, mottled with areas of black, finely white-tipped scales .....36. *discana.*
6. Ground mottled fuscous brown, with a darker, more or less distinct, median fascia.....37. *foxcana.*

2. Ground whitish, strigose, with contrasting blackish base and outer m fringe, and some dark shading at middle of wing.....47. *la*
2. Ground strigose, light gray, with a large square darker patch resti middle of costa, extending more than halfway across wing.....39. *ed*
2. Strigose, light gray on whitish, with a contrasting curved blackish across the apex.....38. *wis*
2. Basal half contrastingly paler, and usually yellower, than apical hal
3. Base ochre yellow, or olive green, apex pink.....34. *œnothe*
3. Base cream, outer two-thirds yellow.....26. *zara*
3. Base yellow on luteous; outer part dark, with brown, gray, and bla markings.....5. *aur*
3. Base cream; median region blackish; outer part shaded with pink *landana*, etc., see group with median fascia).
2. Base and thorax gray; medial area dark; outer part light pink or yell
3. Medial area brown, outer part pink; head concolorous.....27. *visc*
3. Medial area blackish, outer part yellow-brown; head whitish, contras 32. *albid*
2. Yellow without definite markings; inner margin and base paler than and costa.....
2. Yellowish (a little gray-powdered); with a black discal dot, and a below it in the fold, as the only distinct marks.....20. *atomos*

1. **P. rutilana** Hübner. Bright yellow, with four even deep red bands, the ou most not quite terminal, turning inwards at right angles just above inner ma and joining the third band; also often broadly connected with the third band costa, enclosing a yellow patch. First band basal. Hind wing gray with a sli reddish tint. 9–12 mm.

June. Larva brownish yellow, with darker yellow-brown head and cerv shield. In a tubular web between needles of juniper, sometimes injurious.

Maine; New Jersey; Europe. New York: Long Island (introduced about 187

2. **P. labeculana** Robinson. Cream white, with a few fuscous scales. Ba yellow-brown mottled with fuscous, sometimes dark-edged. Base fuscous, follo by a broad area of the white, extending two-fifths way out, and a little shin at the edges of the markings. Median fascia strongly constricted, and, almost in two at Cu_2; the lower part forming a more or less distinct triangular pat outer part cream color, mottled with light and dark fuscous scales, the dark pa tending to form a subterminal costal spot and a nearly marginal fascia. Hi wing gray. 12 mm.

May. Described from a type at Philadelphia.

Pennsylvania; New Jersey. New York: Ramapo.

3. **P. argentilimitana** Robinson. Similar to *P. labeculana;* the bands distinc brassy, with well-marked silver edging, much more shining than the ground, whi is typically purer white. Median band broadly continuous across the cell and fo 11 mm.

These two species are generally confused, and, in fact, may not be distin The type of *argentilimitana* is in very bad condition, leaving the possibility incorrect identification.

Early September.

Pennsylvania to South Carolina and Missouri. New York: Ithaca.

4. **P. interruptofasciata** Robinson. Light ochreous, markings yellow-brown, t medial ones darker. Base brown more than a third way to apex, with clean-cu slightly excurved outer boundary; median fascia represented by a large rounde dorsal spot and a less definite costal one, broadly separated from each other. broad subterminal fascia from costa to dorsal margin, separated from the ape by less than its width, and gradually approaching the outer margin below. Di sometimes shaded with gray. Hind wing mouse gray. 10–15 mm.

and July.
hern New Jersey and Pennsylvania.
aureana Busck. Pattern as in *P. interruptofasciata;* basal area blackish, overlaid with olivaceous on lower half of wing, pale in cell and dark along median spots dark brown, the dorsal one smaller than in *P. interrupto-a,* subterminal band more curved, narrow, and silvery; preceded by a large sh shade nearly connecting it with the median spots. 12 mm.
; July.
markings are obscure, giving the effect of a blackish species with a large ish patch covering the base, except the costa, and a narrow yellowish outer n and fringe.
tern Pennsylvania.
. lepidana Clemens. Deep ochre; median band a little darker, yellow-brown, y defined; extreme base light yellow. An antemedial light transverse line ig the median band, which is edged with somewhat powdery black scaling d the inner margin; a similar edging on the outer side, both widening toward sta, but narrower than in *P. sublepidana.* (The median band is oblique and n width.) A pale line from lower angle of cell to before anal angle, cutting triangular spot of the ground color; this line often heavily dusted with sh; a vertical subterminal line of blackish on a cream base, lying about in iddle of the yellow-brown outer region, its upper end sometimes joining the end of the postmedial line. 10 mm.
ermediate between *P. sublepidana* and *romonana.* Described from the types iladelphia.
nsylvania.
P. sublepidana Kearfott. Fore wing bright ochre; broad antemedial and post-al dark gray bands, both pale-edged, and becoming whitish toward costa; the connected by a longitudinal band equally broad, in middle of wing, reducing round to costal and dorsal spots. Base and terminal margin and fringe much than median and subterminal areas. Hind wing fuscous brown. 9 mm.
ly.
rthern New Jersey.
P. biscana Kearfott. Dull tawny brown to gray-brown, often dotted with n or reticulate on a cream ground; a strongly oblique dark gray streak to l angle, sometimes bent at right angles at middle of wing and faintly con-ed to costa; median line narrow, a little diffuse, bent at right angles at middle, e it may send lines to costa at three-fourths way out and to anal angle, form-an oblique cross; subterminal line narrow, parallel to outer margin below, ing to apex, or, more rarely, fading out toward costa. Hind wing paler, dirty e. 15–23 mm.
ly; August.
aine to western Pennsylvania. New York: Peru.
ariety **giscana** Kearfott is dwarfed, with almost wholly cream-colored ground markings heavy and dark gray, strongly contrasting. Intermediates are tively common.
P. dorsimaculana Robinson: Luteous, with some scattered dark scales, especi-with a dot or group of dots at lower angle of cell. A gray-brown streak nding obliquely up from basal angle, defined on outer side, but on inner side n gradually fading out toward base; a blackish irregular dorsal triangle on r margin two-thirds way to apex; some black subterminal scales, normally uped as a series of double dots between the veins, but rarely extending either apex or dorsal margin. Fringe concolorous, hind wing grayish white to pure te. 10–16 mm. (*angustana* Clemens, not Hübner).
uly to September.

Nova Scotia; Quebec; Pennsylvania; and probably general. New York: Itha Trenton Falls.

P. fernaldana Walsingham. Ground light yellow, including base of wings; mar ings yellow-brown; an angulate antemedial fascia; *an oblique bar to middle costa*, not joining a large triangular patch on middle of inner margin; and co fused outer markings, much as in *P. dorsimaculana*, but typically lighter. 17 m Described from the Pacific Coast and not certainly known from the East. Easte records should probably be credited to *P. promptana*.

10. **P. promptana** Robinson. Pale cream, the markings darker; straw yello with some black scales but not contrasting. Basal mark as in *P. dorsimaculan* normally extending up from very close to base of wing on inner margin, or eve touching base. Median triangle more rounded and not contrasting, with very fe black scales; a well-marked oblique fascia from middle of costa two-thirds way t anal angle, extending down on the outer side of the dorsal triangle; a continuou subterminal band from near the apex almost to the inner margin, with conside able black scaling, which sometimes indicates the double dots of the precedin species. Hind wing nearly white. 15 mm. (*angustana* auct., not Clemens; *dorsi maculana* auct., in part).

June to August.

Canada to Texas. New York: Ithaca.

11. **P. obliquana** Kearfott. Light yellow, heavily shaded with yellow-brown leaving well-defined pale edges to the markings, and a pale yellow fringe. Mark ings yellow-brown; an oblique streak in fold extending a third way to apex, ending in a point on **Cu**, strongly pale-edged; a large median dorsal triangle, a broa oblique fascia extending down from middle of costa, ending just beyond the tip of the dorsal triangle, more or less broken by pale shades on the veins. A costa triangle three-fourths way to apex and a yellow terminal band, finely edged with golden yellow; base of inner margin shaded with yellow-brown, without golden edging. Hind wing brownish white. 20–22 mm.

The fore wing is very acute, the costa and outer margin making an angle of less than 60 degrees, even in the male.

Florida; northern distribution uncertain, but described from North Carolina and Manitoba. I have seen a variety from Virginia in early June.

12. **P. angulatana** Robinson. Light clay-color, more or less dusted with gray, or, more rarely, with red-brown; markings grayish or reddish brown, nearly concolorous with the dusting. Basal area dark, its outer boundary bent at nearly a right angle at middle of wing, and running to inner margin well beyond basal angle; often with the lower part emphasized by a darker shade corresponding to the oblique band of the *obliquana* group. A broad contrasting median oblique fascia to costa, and spot on inner margin, the former not distinctly cut by pale veins; marginal dark band clean-cut, set back a little from the margin, a little irregular, running from apex to inner margin. Hind wing gray. 10–15 mm.

Not rare from July to October.

This species is strongly variable in ground color and slightly so in pattern. One specimen is suffused with fuscous, with the darker fuscous markings not at all contrasting.

Generally distributed. New York: Peru, Slaterville, Ithaca.

13. **P. bomonana** Kearfott. Similar to *P. angulatana*, ground light, lightly dusted with blackish; the markings only partly dark-shaded, partly of the ground color, and only defined by their paler edging; the median fascia cut by pale shades on the veins, and the subapical patch and subterminal fascia hardly paler than the ground, but with distinct pale defining lines and some black scaling. 15 mm.

The type has the basal markings of the same form as in *P. dorsimaculana*, of which it is probably a dark variety, showing the coloring of *P. angulatana*. With this Kearfott has associated a Florida specimen which seems rather to be

ale *angulatana*, with the normal *angulatana* pattern but with the coloring of *similaculana*.
Chicago, Illinois.

4. **P. rana** Busck. Dull fuscous, with a slight purplish tint, mottled and dusted h dull black; base blackish with strongly excurved or almost right-angled outer ndary: a median oblique fascia running down from costa and a rounded spot inner margin, about as in *angulatana;* subterminal spot on costa less distinct, l subterminal fascia barely traceable or absent. Hind wing nearly concolorous. -20 mm.
August and September. Larva on ironweed.
Connecticut, western Pennsylvania. New York: Rye.

15. **P. smeathmanniana** Fabricius. Straw yellow; markings deep brown, narrow l clean-cut, vaguely pale edged. A slight olivaceous shade near base of inner rgin; a narrow brown oblique bar from inner margin at one-third way out to ddle of cell two-fifths way out, with a small spot opposite its tip at middle of sta: three postmedial brown spots, forming a series parallel to this bar, the ddle one sometimes diffuse and sometimes connected to the one on the outer rgin. 15 mm.
July and early August.
Sherbrook, Quebec; Maine; New York; California. New York: Newcomb, Ithaca. The California record may belong rather to the closely similar *P. parallelana* alsingham.

16. **P. scissana** Walker. Light yellow; costa with numerous oblique light brown riæ, but no rounded spots; inner margin with an oblique bar near base, and a unded triangular spot beyond middle, with some gray shading between them. 5 mm.
Nova Scotia. Unknown to me.

17. **P. fuscostrigana** Clemens. Olivaceous, marked with darker olivaceous brown; ie markings broadly edged with shining pale yellow. Base somewhat darkened. ledian fascia from inner margin at one-third way out to just before middle of sta, less oblique than in *P. scissana;* dark brown, suffused with ochre yellow the cell. A small blackish spot on inner margin at two-thirds way out; a nearly rect olivaceous subterminal fascia from costa to inner margin, less oblique than he outer margin, and narrowing toward the inner margin. Fringe checkered in ighter and darker gray. Hind wing gray. 15 mm.
Labrador; northern New Jersey. Distribution uncertain.
This species is usually confused with *deutschiana*, of which it is probably only he eastern form.

18. **P. deutschiana** Zetterstedt. Similar in coloring to *P. fuscostrigana*, but vithout the bright yellow in the cell; the antemedial band more strongly oblique, reaching costa at middle, interrupted by a vague pale shade in cell only; spot on nner margin at two-thirds concolorous with it; subterminal fascia obscure, repre-ented by a strong dark spot on costa only; pale edging of markings not silvery. 15 mm.
Europe; Colorado. Eastern records are probably based on *fuscostrigana*, if the two are really distinct.

19. **P. floccosana** Walker. Straw yellow, shaded with bright ochre on inner margin and disc of wing to two-thirds, and on costal edge to one-third, leaving a narrow yellow streak extending along cell to base. Hind wing almost white. 15 mm. (*confusana* Robinson).
June.
Nova Scotia to southern Ohio. New York: Ithaca.

20. **P. atomosana** Busck. Straw yellow; duller than *P. floccosana*, dusted or shaded with light wood-brown, and more or less dotted with black. A black dot, or usually a group of dots, at lower angle of cell, and a dot below them in the

fold; usually with a more or less complete subterminal series between the v
Hind wing nearly concolorous. 15–20 mm.

August. This species looks like a Bactra, superficially.

New Jersey to Wisconsin.

21. **P. louisiana** Busck. Larger than *P. romonana*. Straw yellow, brighter t
P. romanana; markings deep ochre or yellow-brown. Base somewhat dark-sha
especially at margins; median fascia running from middle of costa to inner ma
one-third way out; somewhat bent and widened at cell, where it is paler, s
times hardly darker than the ground; a small brown spot on inner margin at
thirds; subterminal fascia narrow, irregular, and broken, sometimes suffu
sometimes with its lower end connected with the outer spot on inner marg
set well back from outer margin. Fringe pale. Hind wing gray.

May to July.

Illinois; Missouri, Utah; New York: Ramapo (Kearfott).

22. **P. romonana** Kearfott. Straw yellow, marked with light olive brown; i
somewhat darkened, or with an oblique bar extending up from basal angle; med
fascia narrow on costa and at inner margin; more than twice as broad at mid
of wing; the inner boundary nearly straight except at costa; the outer bound
outwardly oblique to end of cell, then angled or sharply bent and inwardly obli
to inner margin. An oblique fascia from costa at three-fourths way out tow
outer margin, fading out below. Some confused marks on inner margin, a
sometimes a distinct spot at two-thirds way to apex. Fringe concolorous; hi
wing gray. 8–14 mm.

August.

New Jersey to Maryland and Manitoba.

23. **P. hospes** Walsingham. Ochre yellow; median area mixed yellow-brown a
deep purple-gray, in varying proportion, especially toward the costa, forming
large triangular patch, starting narrowly at middle of costa and covering mid
half of inner margin. Outer part with a curved yellow-brown shade starting fr
costa half way between the median patch and the apex, and joining the patch ju
below the cell. Fringe paler yellow. Hind wing brownish gray; the fringe
little paler, with a distinct dark line in its base. 10–15 mm.

August.

This form is *straminoides*, as identified by Busck, but Grote's original descri
tion applies better to the following form.

New Jersey to North Carolina and Wisconsin.

24. **P. straminoides** Grote. Ground light straw yellow; median fascia broa
oblique, narrowing somewhat to costa, from rather before middle of inner marg
to rather beyond middle of costa; typically red-brown on dorsal half, becomi
olivaceous and tending to fade out toward costa; sometimes entirely gray-brow
Outer part of wing broadly shaded with brown or olivaceous, with some blackis
striæ along costa. Hind wing light gray. 9–15 mm. (*schwarziana* Busck, *zaraca*
Kearfott).

Both names seem to apply to the form with the red-brown median fascia.

New York to Maryland and Illinois. New York: Buffalo, Ithaca, Trenton Fall

25. **P. plummeriana** Busck. Similar to *P. straminoides:* rather brighter yello
with apex of fore wing shading into a distinct red-brown patch. Hind wing whit
nearly immaculate. Probably an extreme form of *straminoides*. 13 mm.

June.

Maryland to Illinois. New York: Peru.

Number 26 is vacant.

27. **P. viscana** Kearfott. Base of wing powdery gray; middle of costa fuscous;
a chocolate-brown median shade, not reaching the costa; outer half of wing bright
pink, crossed by a red-brown fascia across the apex; fringe bright ochre yellow

y-brown at apex. None of the markings quite sharply defined. Hind wing brownish gray. 12 mm.
y. Type only known.
thern New Jersey.
P. aurorana Kearfott. Fore wing light ochreous with pink iridescence; in fascia somewhat oblique from middle of costa to inner margin at one-way out, nearly even in width, somewhat excurved, and shaded with black th sides at inner margin; outer part of wing with a triangle on inner margin, cia across apex and a large central patch lacking the pink iridescence, but ontrasting. Fringe concolorous, hind wing dirty white. 12 mm.
gust to early September.
ine and northern New Jersey.
P. hollandana Kearfott. Similar to *P. aurorana;* the outer part of the wing sed with gray, leaving most of the pink along the costal edge; the median a more solidly blackish. Hind wing mouse gray. 13 mm.
ptember. Not improbably a dark variety of *P. bunteana.*
estern Pennsylvania.
P. bunteana Robinson. Basal third cream white, median fascia even, oblique, y broad, abruptly narrowing to costa; mixed yellow-brown and black; outer of wing yellow-brown, heavily shaded with pink; a brown fascia across apex, ed with black, and with some black scaling between it and the end of the cell, gathering in a distinct spot. Often with a mixed black and brown triangle nd the middle of the inner margin, which may fuse with the fascia. 13 mm.
cana Kearfott).
me to September. Larva on *Lactuca scareola.*
ommon, south to North Carolina and west to Manitoba. New York: Wells, ca, Poughkeepsie.
umber 31 is vacant.
P. albidana Walker. Head white, contrasting with the dark gray thorax. e strigose blackish gray, the strigæ much stronger toward the inner margin ally crossed by a well-marked white antemedial shade and with some yellow es in median area. Outer two-fifths ochre yellow, becoming white just beyond gray base and on the costa, with a blackish area beyond it, wider on the costa running out toward the anal angle, and crossed by a whitish transverse stria and. Fringe yellow. Hind wing gray. 10–12 mm. (*winniana* Kearfott; *nana* t., not Hübner.)
May to July.
New Jersey and north. New York: Rock City, Ithaca, Trenton Falls.
Number 33 is vacant.
P. œnotherana Riley. Base of fore wing ochre or olive yellow, outer half or her more, deep rose pink; sometimes enclosing a patch of the ground color; boundary nearly perpendicular to costa. Hind wing dark fuscous brown. mm. General.
April; July; September. Larva a bud worm on evening primrose in June, and ding on the rosette leaves in late fall.
Generally distributed. New York: Vicinity of New York City (Watson).
P. elderana Kearfott. Bright yellow-brown, shaded and reticulate with rker brown; a distinct but diffuse darker median shade, and bar across apex; nge concolorous. Hind wing grayer brown. 12 mm.
July. Larva in pith of swamp elder, in June.
Southern New Jersey.
P. discana Kearfott. Fore wing wood-brown, mottled with finely white-ped black scales, sometimes forming a vague darker median shade. Fringe ncolorous; hind wing brownish gray. 12 mm.
August.
Maryland to Ohio.

37. **P. foxcana** Kearfott. Dull fuscous brown, mottled with blackish, forming vague darker median shade and band across apex. Hind wing nearly concoloro 12 mm.

I suspect this is merely rubbed material of *P. discana.*

With *P. discana.*

38. **P. wiscana** Kearfott. Fore wing white, striate with light gray; the ba of the costa darker; striæ forming a dark shade along middle of inner margi A large lenticular postmedian gray patch from just below costa to inner margi with a brown and blackish band curving around its upper end, running fr costa to outer margin below middle. Apex with some brownish shading. Hi wing gray. 18 mm.

Type only seen.

Milwaukee County, Wisconsin.

39. **P. ednana** Kearfott. Pale gray, sparsely reticulate with dark gray. Bas fifth of wing darker, often contrastingly blackish; with somewhat excurved out boundary; costal half of medial area occupied by a large, rounded, darker, ofi blackish, spot, covering end of cell. A stronger dark subterminal stria, startin from a distinct patch at costa; somewhat more sharply curved than the out margin; typically reaching the inner margin well before the anal angle, but oft fading out. Hind wing light gray. 12 mm.

June and July.

Mount Washington, New Hampshire, and Ottawa, Canada, to Pennsylvania; t specimens showing strong contrasts apparently commoner northward.

This is probably a Cnephasia near *virescana.*

40. **P. temerana** Busck. White, strigose with gray; the base paler than t median area; a mixed yellow-brown and black oblique fascia from inner margi at one-third to outer part of cell, slightly diffuse in outline, and fading out above costal edge shaded with gray; outer third, beyond cell, heavily shaded with yello brown, with a darker brown fascia across apex. Hind wing light gray. 9–15 mm (*cincinnatana* Kearfott).

Western Pennsylvania to southern Ohio.

41. **P. leguminana** Busck. White, base light gray, middle third light gray o dorsal half of wing, defined with black on basal side, leaving a narrow white ban between it and the gray base; costal part of median area somewhat shaded wit gray. Outer part of wing mixed white, gray, fuscous, brown, and blackish; th white clear at end of cell, and usually also subterminally beyond an irregular an broken subterminal dark band, which is roughly parallel to the outer margin Fringe gray with two darker lines. Hind wing brownish gray. 10–15 mm.

Larva in seed pods of Gleditschia.

Pennsylvania to Missouri and Texas.

42. **P. maiana** Kearfott. Dull straw yellow; median fascia contrasting, red brown mixed with black, starting as an oblique fascia at costa, on reaching cel becoming a large triangular patch, almost as broad as its height on inner margin the outer boundary on the whole transverse, the inner one strongly oblique, turn ing a right angle at **R.** Outer part of wing heavily shaded with fuscous an scaled with blackish, leaving a clear quadrate cream patch on costa behind th median fascia, and an obscure one on dorsal margin. Fringe with two obscure darker lines. Hind wing brownish gray. 8 mm.

May.

Northern New Jersey.

43. **P. gunniana** Busck. Similar to *P. maiana;* ground bright ochre yellow; base paler on inner margin and with a slight pink tinge beyond the median fascia; median fascia light yellow-brown, the part below **Cu** overlaid with black, forming a contrasting rounded patch. Outer part with blackish scaling heavier, and a dis

nct largely black band across the apex. Fringe with basal line stronger, but ıter line weaker; outer part of fringe barred with gray. 10–12 mm.
New Jersey to Maryland.

44. **P. hoffmanana** Kearfott. Base cream, its outer boundary oblique from middle costa to inner margin one-third way out; outer part a confused mixture of llow-brown and black, with a white postmedial spot on costa, preceded and llowed by chocolate brown; the outer chocolate brown bar tending to continue as fascia across the apex. Fringe mixed dull yellow and gray. Hind wing dark ay. 12 mm.
May and June.
Black Mountains, North Carolina.

45. **P. zoxcana** Kearfott. Base of fore wing cream, the boundary running from fore middle of costa to inner margin at one-third way out; outer part yellow-own, mixed with blackish; forming a large blackish subterminal patch, with a eam-white postmedial costal spot, and a pale streak at middle of inner margin. ringe with distinct dark basal line. Hind wing dark gray. 8–11 mm.
May and June; August.
Cincinnati, Ohio.

46. **P. toxcana** Kearfott. Base cream white, more or less scaled or shaded with ark gray; a vague yellow-brown median fascia, shaded with gray, nearer base n inner margin; outer third of wing heavily shaded with yellow-brown on a lvery gray base; the brown principally in two oblique fasciæ, the upper crossing ıe apex and partly filled with a small black patch; considerable white scaling in ostmedial region. Fringe dark gray and dull white, with considerable yellow-rown in its base. Hind wing light gray, paler at base. 10–12 mm.
August and September.
Northern New Jersey to western Pennsylvania.
P. marloffiana Busck (*nonlavana* Kearfott) I am unable to distinguish from *. toxcana*. The type differs only in the greater extension of the black and gray t the expense of the yellow-brown; but *toxcana* Kearfott is included in Busck's onception of *marloffiana*. Busck's name has a few weeks' priority.
April; August.
Western Pennsylvania; Maryland, southern Ohio. New York: Ithaca.

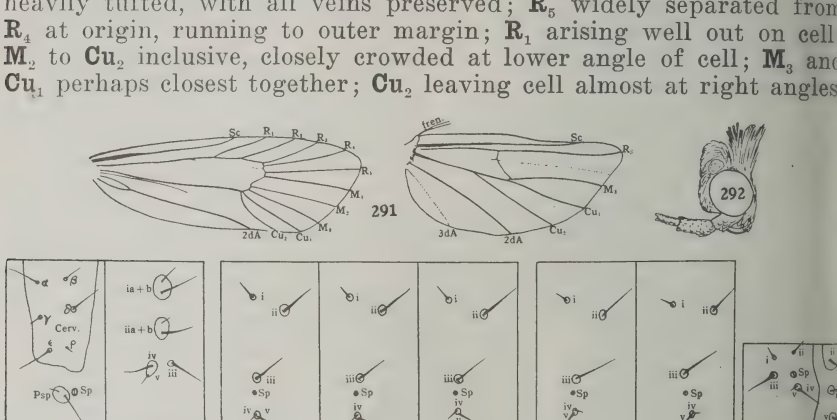
47. **P. lavana** Busck. Similar to *P. toxcana*, but lighter and apparently broader-inged. Head pale; costal edge with black points, base much shaded with light ray; extreme base blackish; median oblique fascia narrow, blurred, and often bscure, mixed ochreous and light gray, the gray dominant; median fascia fol-owed by a well-marked whitish area; outer part of wing mixed light gray and chreous, with some black scaling; the bar across apex rather distinct and largely lack-filled. Fringe dark gray with a little yellow in base (*nonlavana* Kearfott; *ubitana* auct., not Kearfott). 10 mm.
June; August. Larva on Pentstemon.
I have seen this species determined as *campicolana* Walsingham. Some speci-nens show practically no yellow.
Nova Scotia to British Columbia, and south to southern New Jersey and Missouri. New York: Ithaca.

30. Family **CARPOSINIDÆ**

(Tortricidæ, in part)

Head as in the Tortricidæ. Ocelli absent. Tongue rather weak; ıntennæ heavily ciliate in male. Palpi strongly dimorphic in the exes; in male (fig. 292) upturned, with second joint heavily scaled on lower edge and a short close-scaled third joint well set off; in

female, long and oblique, the second joint straight and smoothly scaled on the lower side but with long vestiture on the upper; the third joint short, nearly smooth, and porrect. Thorax and legs scaled; the hind tibiæ more or less hairy, as usual. Wings thin and soft, with long fringe (fig. 291); with arched costa and curved, oblique outer margin, as in the broad-winged Œcophoridæ (Semioscopis). Fore wing heavily tufted, with all veins preserved; $\mathbf{R}_5$ widely separated from $\mathbf{R}_4$ at origin, running to outer margin; $\mathbf{R}_1$ arising well out on cell; $\mathbf{M}_2$ to $\mathbf{Cu}_2$ inclusive, closely crowded at lower angle of cell; $\mathbf{M}_3$ and $\mathbf{Cu}_1$ perhaps closest together; $\mathbf{Cu}_2$ leaving cell almost at right angles



FIGS. 291–293. CARPOSINIDÆ

291, *Carposina fernaldana*, venation; **292**, *Bondia crescentella*, male, side view of head; **293**, *Carposina fernaldana*, seta map of larva.

and then curving, as in many Œcophoridæ. **1st A** lost, **2d A** shortly but strongly forked at base. Base of $\mathbf{R}_{4+5}$ and of **M** obsolete. Hind wing with cell closed. **Sc** normal, apparently free, but closely approximate to **R** at base; **R** normal; $\mathbf{M}_1$ lost in the American species, represented by a fold running from just above the middle of the cell; $\mathbf{M}_2$ from, or from just above, lower angle of cell; $\mathbf{M}_3$ lost (perhaps completely fused with $\mathbf{Cu}_1$); $\mathbf{Cu}_1$ from lower angle of cell; $\mathbf{Cu}_2$ from two-thirds or three-fourths way out on cell, normal, straight; the American species with a weak fringe of hair on **Cu**. Veins **1st A** and **3d A** rather weak; **2d A** with a well-marked fork at base.

Larva (fig. 293) with only two setæ on prespiracular wart; **vii** of two setæ on prothorax, one on meso- and metathorax and eighth segment of abdomen, two setæ on first and seventh segments, and three on second as well as on the leg-bearing segments. Abdomen with

etæ **iv** above **v**; prolegs with a small complete ring of uniordinal ooks. Eighth segment much reduced dorsally, with spiracle enlarged, orsal, on a level with setæ **iii**; **ii** rather higher than **i**. Ninth segment ith setæ **ii** well separated, but on a single plate. Pupation in a cocoon f brittle silk, covered with sand, in the ground. Pupa not described. The larvæ, as far as known, are borers in fruits, and one is injurious o peaches in Japan. The family is small and probably very old. It is f uncertain relationship but perhaps cognate with the Phaloniidæ. Iost of the hundred known species are from Hawaii and Australasia.

Key to the genera

M_2 and **Cu_1** of hind wing separate.....2. *Bondia.*
M_2 and **Cu_1** connate.....1. *Carposina.*

1. *CARPOSINA* Herrich-Schæffer

Male with a heavy tuft on lower side of second segment of palpus; the palpi losely upturned. Wings broader; fore wing (fig. 291) with an oblique series of hree tufts near base, an antemedial series parallel to it, the middle one located n cell **Cu**, and very weak, the ones below costa and above **A** strong; strong tufts elow **Cu** farther out, above and below cell, and a couple at end of cell. Hind wing ranslucent, with strong fringe of hairs on base of **Cu**; **M_2** and **Cu_1** connate or hortly stalked; costal margin strongly sinuate in female. Postmedial shade of ore wing wavy and indented opposite lower angle of cell.

1. **C. fernaldana** Busck. Palpus of male with tuft moderate and rounded at nd; fore wing powdery gray, the costa concolorous, mottled with darker gray. 'ufts blackish-tipped; a black bar or patch in end of cell; postmedial line diffuse, xcurved, indented opposite lower angle of cell, and slightly dentate on veins. A series of fine black terminal dots. Hind wing translucent, pale gray. 18 mm.
Late July and August. Larva in nearly ripe currants.
New York to Illinois and Missouri. New York: Ithaca.

2. **C. nicholsana** Kearfott. Palpal tuft in male much larger, and triangular; ore wing with practically the same pattern, but with the base of the wing and he costa above **Sc** contrastingly dark, sometimes almost wholly dark gray. Blackish patch in end of cell in a dark shade. Terminal dots larger, lighter, and liffuse, often partly confluent. 15 mm.
Nicholson, Pennsylvania.
July.

3. **C. ottawana** Kearfott. Wings narrower, though broader than in *B. crescentella.* Palpal tuft triangular. Fore wing duller fuscous, powdery, but not contrastingly so; antemedial region, from the first row of tufts to the middle, broadly shaded vith white; blackish patch in end of cell and postmedial line nearly lost in the general fuscous ground; terminal dots obscure. Hind wing more opaque, darker gray. 16 mm.
June.
Ottawa, Ontario.

2. *BONDIA* Newman

(*Carposina,* in part)

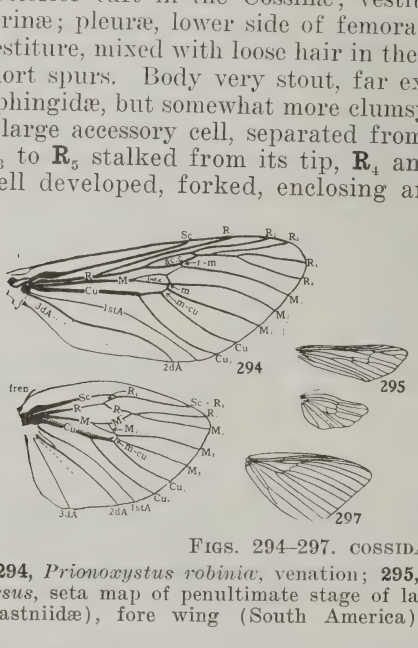
Near Carposina. Palpi of male with a slight tuft at end of second segment only (fig. 292); wings narrower, scaling coarse, hind wing with **M_2** and **Cu_1** listinctly separate.

1. **B. crescentella** Walsingham. Powdery gray; markings much like *C. fer dana*; the postmedial shade strongly and evenly excurved; the larger tufts w contrasting yellow scales on their upper and outer sides, the one at the end ths cell showing as a yellow and white crescent to the naked eye. 13 mm.
May.

General in distribution, South of Pennsylvania. New York: Rock City (rare), Big Indian Valley.

Family 31. **COSSIDÆ** (Zeuzeridæ)

Head with erect vestiture, sometimes forming a distinct tuft vertex; no ocelli; male antennæ, in the North American species, pec nate, at least toward the base. Shaft scaled on the upper side, the scal irregular and often ephemeral. Palpi upturned to middle of fro (Cossinæ) or very short (Zeuzerinæ); the other mouth-parts rudime tary. Thorax with spatulate vestiture, usually rather close, with posterior tuft in the Cossinæ; vestiture loose and woolly in the Ze zerinæ; pleuræ, lower side of femora, and abdomen also with spatula vestiture, mixed with loose hair in the Zeuzerinæ. Legs stout, often wi short spurs. Body very stout, far exceeding the hind wings, as in t Sphingidæ, but somewhat more clumsy. Fore wing (figs. 294, 295) wi a large accessory cell, separated from the discal cell by a strong vei $\mathbf{R}_3$ to $\mathbf{R}_5$ stalked from its tip, $\mathbf{R}_4$ and $\mathbf{R}_5$ the farthest; base of med well developed, forked, enclosing an intercalary cell in our specie



FIGS. 294–297. COSSIDÆ AND CASTNIIDÆ

294, *Prionoxystus robiniæ*, venation; **295,** *Zeuzera pyrina*, venation; **296,** *Coss cossus*, seta map of penultimate stage of larva (Europe); **297,** *Castnia harmodi* (Castniidæ), fore wing (South America).

1st A fully developed; **2d A** strongly forked at base. Hind win proportionately small; frenulum ordinarily well developed, rarel lost; humeral vein sometimes distinct, running across to base o frenulum; $\mathbf{R}_1$ variable; when present, arising near middle of cell o beyond; exceptionally long and strong in Prionoxystus, where it i well beyond the middle of the cell, sometimes supplemented by

econdary cross vein beyond end of cell; base of **M** developed, forked; ll three anals strong and complete; the second shortly forked at base. gg of upright type, with longitudinal ribs and reticulate micropyle n the Cossinæ; of flat type, oval and smooth, in the Zeuzerinæ. Larvæ oring, usually in solid wood, the smaller species more often in her- aceous perennials; as a rule spending two or more years in the larva age. Larva (fig. 296) stout, with a relatively small head, held hori- ontally; shields and tubercles large and heavily chitinized; labrum ardly notched, mandibles very large, and projecting forward. Ocelli ormal. Front not reaching more than half way to vertex; adfrontals ort in Zeuzera, reaching to the slightly cleft vertex in Cossus. Body- tæ as in other Tortricoidea; setæ **ii** of ninth segment of abdomen at ast as far apart as on other segments; setæ **iii** of abdomen duplicated n Cossus. Prolegs with hooks variable.

Pupa incomplete, with second segment of abdomen fixed; mandibles eparately chitinized; head sutures mostly distinct; dorsal headpiece udimentary but carrying the eye pieces on dehiscence; front with a pecialized cocoon-breaker in the Zeuzerinæ; maxillary palpi separate n Cossus, imperfectly separated in Zeuzerinæ; antennæ not reaching nd of legs, widely separated; tongue very short, the two halves sepa- ated by the labial palpi in the Cossinæ. Base of labium well developed, nd palpi fully exposed. Cremaster not developed; end of abdomen ore or less truncate, with a group of angulate projections. Early tages of Hypoptinæ not studied.

This is in many ways, notably in venation, one of the most primitive amilies of Lepidoptera, and at the same time is the base of a series eading directly to the butterflies. The only definite butterfly character n this family is the upright egg of the Cossinæ. In the Castniidæ fig. 297) the tongue, which is lost in the Cossidæ, is preserved; the abits have become butterfly-like; the upper fork of **M** is lost; the vings have become ample and the cell relatively small; and the ntennæ are clubbed. In the Neocastniidæ, which are in other ways berrant, $\mathbf{R}_1$ has become stalked beyond the origin of $\mathbf{R}_{4+5}$, as in pupæ f butterflies. The Euschemonidæ have lost the base of **M** and **1st A** n both wings, differing from our local skippers only in the more woolly estiture and the presence of the frenulum. They also have the skipper ype of larva, with secondary hair, and well-set-off head.

Key to the genera

1. **1st A** and **2d A** connected by a cross vein near margin.....1. **Givira.**
1. **1st A** and **2d A** free.
2. Lower fork of base of **M** running across to dorsal margin of cell; male antennæ pectinate halfway to apex.....4. **Zeuzera.**
2. Both branches of base of **M** ending in outer margin of cell; male antennæ pectinate to apex.

3. Sexes similar; male with rounded hind wings; female with simple laminate antennæ.....2. **Acossu**
3. Sexually dimorphic; male with outer margin of hind wing nearly straigh female with pectinate antennæ.....3. **Prionoxystu**

Subfamily **HYPOPTINÆ**

Smaller species, the larvæ probably normally in roots of perennial herbs; mot tending strongly to lose tibial spurs and frenulum. A strong cross-vein near outc margin, between **1st A** and **2d A**; other characters as in Cossinæ; larva not we known.

1. *GIVIRA* Walker

(*Inguromorpha; Hypopta,* in part)

Male antennæ pectinate to apex, in female normally very narrowly pectinate palpi moderate, upturned; accessory cell small, but well set off from discal cel intercalated cell inconspicuous. Hind wing with R_1 rudimentary, R_s and M stalked. Vestiture spatulate.

1. **G. anna** Dyar. Gray, evenly recticulate with lines of black powdering, disc lunule white; inner margin narrowly white at base. Hind wing darker, unmarke 25–30 mm.

Florida; St. Louis, Missouri; and probably in intermediate country.

The St. Louis race is darker than the type.

Subfamily **COSSINÆ**

Egg upright; strongly ribbed; with well marked micropyle. Larva with cervic shield moderate and smooth, spiracles in line; crotchets in our two genera trio dinal, in a complete circle; in the genus Cossula (which is transitional to th preceding subfamily) crotchets uniordinal in two transverse rows. Pupa wit maxillæ not meeting in middle line beyond end of labial palpi; maxillary palp separately chitinized; head smooth. Imago with male antennæ pectinate to apex or entirely simple, laminate; palpi moderate; intercalated cell triangular, normal **1st A** and **2d A** free; hind wing with **R** and M_1 connate or stalked; M_2, M_3, an Cu_1 more or less approximate.

2. *ACOSSUS* Dyar

(*Trypanus, Cossus,* in part)

Vestiture of thorax deep, spatulate, but regularly imbricated, with posterio tuft; male antennæ pectinate to apex; female antennæ laminate below; palp moderate, upturned. Fore wing with large accessory cell; R_1 arising from disca cell, R_2 from accessory cell, R_3 connate with R_{4+5}, which are stalked less than half way to apex. Intercalated cell triangular, not reaching posterior margin of disca cell; anals not connected. Hind wing relatively large, with **Sc** and **R** connecte by a strong vein about two-thirds way out on cell; **R** and M_1 shortly stalked M_2, M_3, and Cu_1 approximate at base.

1. **A. centerensis** Lintner. Thorax and basal half, or rather more, of fore win blackish; collar often partly light gray; thorax spotted with whitish. Outer part of wing contrasting, pale gray; the whole wing dusted and heavily reticulate with black. Hind wing translucent, very lightly reticulate, with blackish fringe Hair in base of anal region blackish. 50–60 mm. (**H 12**:1.)

Larva boring in poplar. Tubercle iii of metathorax fully as large as iia+b

Montreal, Quebec, to New Jersey and Illinois. New York: Peru, Batavia, estershire, Karner (type), Brooklyn.

2. **A. populi** Walker. Fore wing light gray, strongly reticulate, the reticulation little denser in the antemedial region. Hind wing strongly reticulate on outer alf of wing, with checkered fringe. No dark hair at the base. 60 mm.

July.

Hudson Bay; Hymers, Ontario.

3. *PRIONOXYSTUS* Grote

(*Xystus* Grote, not Hartig; *Xyleutes*, in part)

Similar to Acossus; sexes unlike; the male much smaller, with the outer margin f the hind wings nearly straight; female with bipectinate antennæ; vestiture ightly shorter, practically of plain scales on top of thorax. (Fig. 294.) Larva ith tubercle iii of metathorax decidedly smaller than ii a+b.

1. **P. robiniæ** Peck. Fore wing nearly white, slightly translucent, irregularly riate with black; the middle of the wing covered by an irregular darker patch, pecially in the male. Hind wing of male bright yellow, the basal half and costa bove R_1 blackish; outer margin narrowly black. Female with hind wing smoky ray, the reticulation of the under side showing through faintly. 50–75 mm. *plagiatus* Walker). (**H 41**:11, ♂; 10, ♀.)

Female variety **reticulatus** Lintner lacks the blackish patches in the median rea of the fore wing, which is only a little more heavily reticulate there; is a ttle smaller and more translucent and is commoner southward. In female aber- ation **quercus** Ehrman, the female hind wing is almost as bright yellow as that f the male.

Generally distributed. New York: Plattsburg, Peru, Ogdensburg, Brockport, uffalo, Ithaca, Oneonta, Albany, Staten Island; Long Island, common at Brooklyn. ne Ithaca specimen is practically var. *reticulatus* Lintner.

Not very rare, but easily overlooked, the moth being short-lived and not flying o sugar, or often to light. It is most easily found resting on the trunk of its ood plants. Larva boring in many trees, preferring soft woods; perhaps most ften in poplar and locust; often doing serious damage to unhealthy trees.

2. **P. macmurtrei** Guérin. Fore wing with reticulation mostly transverse, in he female with one well-marked stronger stria from costa to anal angle just eyond the cell; no dark shading in median area. Hind wing of male nearly trans- arent, with a very slight yellow tint, blackish along the inner margin. ♂ 30, ♀ 0–75 mm. (*querciperda* Fitch).

June. Larva boring in oaks. Rare in collections.

Widespread but apparently quite local in distribution, west to Minnesota.

New York: Buffalo, Ithaca, Schoharie, Crugers, Newburgh, New York City, taten Island; Brooklyn, Woodhaven, and Newtown, Long Island.

The two species have been much confused, especially in the larva, making food ecords a little uncertain.

Subfamily **ZEUZERINÆ**

Egg ovate, flat, smooth; larva with cervical shield extremely large, rough; last piracle raised, as in Carposina; crochets slightly irregular, but nearly uniordinal, upa with maxillæ meeting in middle line beyond end of labial palpi; maxillary alpi not separately chitinized, separated by a partial suture; head with a charac- eristic toothed projection. Imago with male antennæ pectinate only on basal por- ion, the pectinations curved and forming a sort of eye-cap; vestiture deeper; base f M_3 transverse, and intercalated cell rectangular. Veins of hind wing, especially R and M_1, widely spaced.

4. *ZEUZERA* Latreille

Male antennæ broadly bipectinate on basal two-fifths, the rest simple. Fema antennæ simple; vestiture woolly, largely mixed with long spatulate scales and hair both wings (fig. 295) with stem of M_3 running directly across to the lower side the cell, making the intercalated cell nearly rectangular. Hind wing with R_1 rud mentary, but visible in a well-bleached wing, functionally replaced by a secondar crossvein at end of cell; all veins arising well separated, from end of cell. Fren lum strong; palpi rudimentary; hind tibiæ with end spurs only. Larva whit cervical shield very large, rough, and black; tubercles black, skin white; las spiracle raised. Larva boring in the twigs the first fall, then moving down t the trunk or larger branches (fig. 295).

1. **Z. pyrina** Linnæus (Leopard moth). White, regularly spotted with blue black; the hind wings sometimes nearly all white; abdomen blue-black. 45–70 mm (*æsculi* Linnæus) (**H 9**:9.)

Larva a general feeder on trees, but really attacking perfectly healthy ones often a serious pest under city conditions.

Vicinity of Boston, Massachusetts, and New York City; introduced from Europe New York: Vicinity of New York City, and north to Kensico, Westchester County

SUPERFAMILY **PYRALIDOIDEA**

Slender, usually moderately small moths. Head prominent, usually with ocelli; antennæ almost always simple, ciliate, with two dorsal rows of scales on each segment; the reticulation of the unscaled surface usually (except Orneodes) forming hexagonal meshes. Male antennæ frequently with a process on the scape (Phycitinæ, Epipaschiinæ, Omphalocera) or a notch and tuft on the shaft (Desmia). Palpi usually moderate or long, very often projecting beak-like (whence the name "snout-moths" for the group); much reduced in males of Galleriinæ. Tongue almost always scaled at base. Wings usually close-scaled, the scales attached more firmly than in most of the lower families. Fore wing varying from narrow to ample; the discal cell always well-formed, but accessory cell always absent. **Cu** apparently 4-branched, base of media lost; **1st A** usually lost. Hind wing with **Sc** and **R** closely parallel to beyond end of cell; often fused for a greater or less distance. Base of **R** often lost by atrophy, the tip of **Sc** very rarely lost, leaving the basal part of **Sc** and the tip of **R** to form the most anterior vein of the wing. **1st A** almost always preserved. Legs usually long, sometimes extremely long.

Eggs of flat type. Larva with prespiracular wart with only two setæ, except in the few forms with tufted hair. Setæ **iv** and **v** approximate on abdomen, usually on the same tubercle. Rarely with tufted or secondary hair, and only in forms with round spiracles. Larvæ of almost all the species concealed feeders. Pupæ obtect, with apex of labrum bilobed (indicating the pilifers); and antennæ long, not swollen outwardly. Eighth segment of abdomen free from seventh in males of Pterophoridæ only.

This large group is formed mostly of the family Pyralididæ. The Pterophoridæ are undoubtedly related, though more specialized in some ways and more generalized in others. The Orneodidæ are of doubtful affinity, and are placed here mainly for convenience.

Family 32. **THYRIDIDÆ**[33a]

(*Thyridæ; Sphingidæ,* in part, of the older authors)

Ocelli absent; eyes small; tongue and labial palpi strong; maxillary palpi obsolete. Hind tibiæ of male enlarged with a pencil of hair. Fore wing with all veins present, in the northeastern species all arising separately from the cell, or with $\mathbf{R}_2$ and $\mathbf{R}_3$ very shortly stalked. *No distinct patch of spinules* near base of inner margin; **1st A** absent.

[33a] The figures for this family are on page 333.

Hind wing with **Sc** and **R** wholly independent, but approximat (Thyris, fig. 196); or fused (Dysodia, fig. 195) beyond middle o cell; the other veins normally all arising separately; **1st A** lost bu **3d A** strong. Cells open.

The species of temperate climates agree with the preceding descrip tion, and are small, heavy-bodied moths with thick vestiture an transparent discal spots. The tropical Rhodoneurinæ are more sle der, with ample wings. They frequently have some radial branche stalked; **Sc** and **R** of the hind wing are approximate beyond the en of the cell; and the cells normally are closed. They link the typica members of the family with the Pyralididæ.

Caterpillars (fig. 197) superficially Pyraloid, but more primitiv than any Pyralid in having three setæ on the prespiracular wart of th prothorax at least in some specimens (Fracker). Primary setæ only Head smallish, and normal; front reaching more than half way to vertex Mesothorax and metathorax with tubercle **vii** bearing two setæ. Abdo men with setæ **iv** and **v** on a single tubercle, **vii** of two setæ on firs and seventh segments, and single on eighth. Ninth segment with a pre anal plate bearing setæ **i** in front of, and slightly above, **ii**. Proleg rather long, with a complete series of biordinal hooks. Spiracle oval. Caterpillars concealed feeders; immaculate, except for th black chitinous parts. Pupa solidly obtect, not studied.

The family is a wholly isolated and very strange one, combinin characters of the Pyralids and Macrolepidoptera with primitive feat ures. Its nearest relatives seem to be the tropical Hyblæidæ. Fracke has placed the group in the Tineid series; but it appears on the whol nearer the Pyraloids.

1. *THYRIS* Laspeyres

Palpi obliquely upturned, with broad, bladelike second joint; male antenna prismatic and thick. Hind tibiæ stout, with large, crowded spurs. Abdome heavily tufted at sides toward rear. Fore wing with R_2 and R_3 well separated Hind wing with **Sc** and **R** separate (fig. 196). Larva with adfrontal sclerites eve in width.

Key to the species

Fore wing marked with yellow ..... 1. *maculata*
Fore wing black and white ..... 2. *lugubris*

1. **T. maculata** Harris. Outer margin strongly wavy. Black. Stripes on abdo men, a subterminal series of spots on wings, and scattered spots, all bright tawny yellow. A large, squarish, hyaline patch in the end of the cell of each wing, and a similar patch on inner margin of hind wing, sometimes fusing with the discal one. 12–15 mm. (**H 47**:30.)

End of May to July; not common and quite local in occurrence. Larva probably a stem borer or leaf-roller on clematis.

Montreal, Ontario, to Montana; south to District of Columbia. New York: Lancaster, Newport, DeBruce, Kingston, Poughkeepsie, Esopus, Long Island.

2. **T. lugubris** Boisduval. Black, with translucent white markings; pale patches on tegulæ; two or three white bars on body; a hyaline patch below the cell on fore wing, as well as the one in the cell, often fused with it; hind wing with a broad median fascia; and a very irregular series of subterminal white spots, one opposite the cell of the fore wing largest. 15–23 mm. (**H 47:31.**)

June. Larva on grape.

Southern States, north to Ithaca, New York. New York: Ithaca (Eyer), Karner, Bronxville, Staten Island; Brooklyn, and Wading River, Long Island.

2. *DYSODEA* Clemens

(*Thyris,* in part; *Platythyris* Grote)

Similar to Thyris. R_2 and R_3 of fore wing at least somewhat approximate; Sc and R of hind wing anastomosing (fig. 195). Larva with adfrontals wider toward the top.

1. **D. oculatana** Clemens. Yellow, reticulate with brown, with antemedial, postmedial, and subterminal darker brown bands. Transparent discal spot small and rather triangular. Hind wing similar, less obviously banded, with a large, lunate, discal spot. 20 mm. (*fasciata* Grote and Robinson). (**H 3:10.**)

The moth flies early in July. The larva appears to be a rather general feeder and lives in a dirty and foul-smelling nest. It has once or twice proved injurious by eating into beans, and is easily recognized by its smell.

The distribution seems general but I have very few records.

Pennsylvania; West Virginia; and southern Canada.

2. **D. vitrina** Guenée. Brown, with reddish areas near outer margin and on hind wing only. Transparent spots as in *D. oculatana.*

Larva a stem borer and leaf roller on beans.

Georgia.

This species or form appears not to have been taken since its original description.

Family 33. **PYRALIDIDÆ**

(Snout moths)

Hind wing never divided into three or six feathers; divided in two in a single Australasian genus. Fore wing entire, except in the same genus. Fore wing with **1st A** usually lost. Hind wing without special scaling along **Cu** beneath. Larva with primary setæ, and moderately developed prolegs; with bi- or triordinal hooks except in the Chrysauginæ.

In the subfamilies Glaphyriinæ, Pyraustinæ, Nymphulinæ, Scopariinæ, Crambinæ, Anerastiinæ, and Phycitinæ, the antennal socket is normally separated from the eye by a row of scales; in the Pyralidinæ, Epipaschiinæ and a few others, they are normally in contact.

The Pyralididæ are second largest of the families of Lepidoptera, totalling about 10,000 species. The subfamily Pyraustinæ is predominantly tropical, the Phycitinæ mostly in the temperate zone. The Chrysauginæ and Macrothecinæ are practically confined to the New World, while the Endotrichinæ and several small groups are almost confined to the Old World.

Key to subfamilies; imago

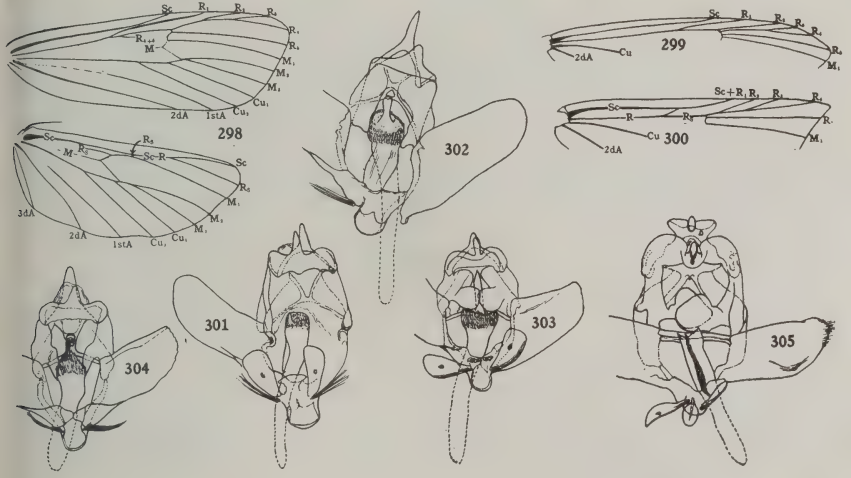
1. Vein **1st A** preserved in fore wing (fig. 298); tongue weak or absent; fring on **Cu** weak or absent. p. 525.....**Schœnobiinæ**
1. Vein **1st A** absent in fore wing.
2. Vein **3d A** of fore wing running into **2d A** near base of wing (figs. 306 t 308, 312, 315).
3. Tongue and ocelli absent; male with third segment of palpi rudimentary
4. Front with a conical tuft; general vestiture deep and mixed. p. 532. **Galleriinæ**
4. Front and thorax smooth-scaled. p. 535.....**Macrothecinæ**
3. Tongue and ocelli present, palpi normal.
4. Maxillary palpi rather well developed; **Sc** of hind wing free (fig. 362) p. 584 .....**Pyralidina**
4. Maxiliary palpi absent; **Sc** and **R** of hind wing anastomosing, p. 528. **Chrysauginæ**
2. Vein **3d A** of fore wing free, or curving into **2d A** near middle of wing (fig 320), forming a wide loop, often rudimentary.
3. M_1 in hind wing arising from closing vein of cell, widely separated from **Sc** (fig. 367); **R** more or less weakened; cell finely closed. Labial palpi beak-like and maxillaries triangular. p. 588.....**Ancylolomiinæ**
3. M_1 closely approximate to **R**.
4. R_5 stalked with R_{3+4}; one free vein only, below the forked vein running to the apex from the radial stem.
5. R_3 and R_4 of fore wing completely united; fringe on **Cu** of hind wing strong.
6. Cell of hind wing closed by a fine but nearly complete vein; frenulum of female simple.
7. Tongue strong, separating the palpi toward the base. p. 608. **Phycitinæ.**
7. Tongue rudimentary, concealed by the palpi when coiled. p. 637. **Anerastiinæ.**
6. Cell of hind wing widely open, frenulum of female multiple. p. 604. **Crambinæ** (*Raphiptera*).
5. R_3 and R_4 stalked.
6. A heavy fringe on base of **Cu** of hing wing; labial palpi beak-like and maxillary palpi triangular. p. 589.....**Crambinæ.**
6. Fringe on base of **Cu** very light or wanting; maxillary palpi plumose, or small and concealed.
7. Fore wing with raised scale-tufts. p. 604.....**Epipaschiinæ.**
7. Fore wing smooth. p. 584.....**Pyralidinæ.**
4. R_5 free; two free veins from radial stem below the forked one (fig. 320); **Sc** and **R** of hind wing almost always anastomosing.
5. Fringe on **Cu** heavy; palpi beak-like, with trangular maxillary palpi. p. 589 .....**Crambinæ.**
5. Fringe light or absent; palpi rarely beak-like; maxillary palpi usually moderate or small and not triangular.
6. No loose spatulate scales on dorsal part of hind wing.
6. Some loose hair near inner margin of hind wing, part of it forming a weak fringe on **Cu** which runs into a group of spatulate hairs or scales below **Cu.** p. 536.....**Glaphyriinæ.**
7. R_2 stalked with R_3 and R_1 (fig. 346) p. 574.....**Nymphulinæ.**
7. R_2 free.
8. Labial palpi beaklike; maxillary palpi large and triangular (fig. 354); fore wing usually slightly rough-scaled; with M_1 well separated from R_5 at origin, about as far from base of R_{3+4} as from M_2. p. 581.....**Scopariinæ.**

8. Labial palpi often upturned; maxillary palpi (fig. 339, etc.) very rarely large and triangular (Loxostegopsis), and in that case with R_{3+4}, R_5, and M_1 closely approximate. p. 541.
Pyraustinæ.

Subfamily SCHŒNOBIINÆ

(*Crambinæ*, in part)

Male antennæ simple, laminate, except in a few exotic species; palpi long, almost always porrect; maxillary palpi large, triangularly tufted; tongue very weak or absent. Thorax often with vestiture of fine loose hair. Fore wing (fig. 298) with outer margin curving more evenly into inner margin than in most Crambinæ; **R** with all five branches preserved; R_5 free in our species, and R_2 frequently free; **1st A** a developed tubular vein at margin, with interspaces of the normal width between it and the veins above and below it; usually curving down to inner margin; **2d A** almost always ending in inner margin; **3d A** short and free, obscure. Hind wing with a slight fringe on base of **Cu**, or none; female with frenulum of several bristles; **Sc** and **R** anastomosing beyond end of cell; M_1 from upper angle of cell or shortly stalked with **R**; dorsal veins all present and normal.



FIGS. 298–305. PYRALIDIDÆ (SCHŒNOBIINÆ)

298, *Rupela albinella*, ♂, venation; **299,** *Schœnobius melinellus*, venation of costal half of fore wing; **300,** *Patissa parthenialis*, venation of costal part of fore wing; **301,** *S. sordidellus*, ♂, genitalia (right valve removed) seen from ventral view; **302,** *S. nitidellus*, ♂, genitalia; **303,** *S. unipunctellus*, ♂, genitalia; **304,** *S. mellinellus*, ♂, genitalia; **305,** *S. longirostrellus*, ♂, genitalia.

The Schœnobiinæ are a small group of more or less aquatic moths, much like the Crambids, but weaker-winged. The wings are normally more loosely rolled in repose. The moths are locally common in wet places. The larvæ are hardly known, structurally, and are borers in marsh and aquatic plants. In one European genus, Acentropus, the larva is completely aquatic and the female of the summer brood is wingless and lives under water.

Key to the genera

Palpi upturned; fore wing with R_2 to R_4 stalked.....1. **Rupela.**
Palpi porrect, beak-like; R_2 free.....2. **Schœnobius.**

1. *RUPELA* Walker

(*Scirpophaga,* in part)

Palpi upturned, loosely held. Thorax with loose soft hair. Fore wing (fig. 298) with R_2 shortly stalked with R_3 and R_4; R_1 anastomosing shortly with Sc in our species and hind wing with M_2 and M_3 stalked. M_1 long stalked with Sc+R.

1. **R. albinella** Cramer. White, immaculate. 25 mm. (*nivea* Walker).
June. Northern specimens are small.
New York, Snake Hill, New Jersey, and south. New York: Staten Island.

Patissa xantholeucalis Guenée ranges north to North Carolina. Its palpi are beak-like but not long, R_2 is stalked, and R_1 nearly obsolete (fig. 299). The wings are white, with two yellow bands.

2. *SCHŒNOBIUS* Duponchel

(*Chilo,* in part)

Palpi beaklike, as long as head and thorax, and down-curved at apex. Thorax without long loose hair; fore wing (fig. 299) with R_1 joining Sc, R_2 and R_5 free.

The species are both close and variable and not fully understood. Some species are sexually dimorphic, the female being paler, and often narrower winged than the male. There appear to be good structural characters, but they have never been worked out. The following key is incomplete but may be of some use as a guide. The genus is a very difficult one in the South and is not well understood, but in New York and the North generally only the well-characterized *S. sordidellus, melinellus,* and *longirostrellus* seem to occur.

Key to the species

1. Hind wing infuscated, fore wing fuscous (males).
  2. Expanse 25 mm.....3. *nitidellus.*
  2. Expanse 40 mm.....2. *sordidellus.*
1. Hind wing white.
  2. Expanse over 50 mm.; yellow with brown markings.....1. *maximellus.*
  2. Smaller.
    3. Postmedial line straight, running from apex to a dot in the fold two-thirds way to margin; wings broader; sexes similar..6. *longirostrellus.*
    3. Postmedial line fading out, or running into a longitudinal streak; wings narrower, especially in females.
      4. Males.
        5. Fore wing smoky.....4. *unipunctellus.*
        5. Fore wing yellow.....5. *melinellus.*
      4. Females.
        5. Expanse over 35 mm.....2. *sordidellus.*
        5. Expanse under 35 mm.
          6. Smoky or straw yellow.....4. *unipunctellus.*
          6. Bright ochre, or overlaid with brown, leaving at least a yellow costa .....5. *melinellus.*

1. **S. maximellus** Fernald. Male unknown. Dull ochre with a blackish longitudinal shade from base to apex; an oblique series of blackish postmedial dots

n veins, the uppermost 1 mm. before the apex; those on Cu_1, Cu_2, and A obscure; ub-basal, antemedial, and postmedial black dots in fold, the latter well beyond he series on the veins; and black terminal points. 55 mm.

Southern States in June.

2. **S. sordidellus** Zincken. Male with blunt squarish wings; dull fuscous; fore ving with black discal and terminal dots; a postmedial series from just before ipex to three-fourths way out on inner margin; obscure below. Hind wing con-olorous, slightly paler at base. 30–25 mm.

Uncus pointed; gnathos emarginate; bearing a spine nearly as long as the incus; transatilla with rudimentary free lobes; juxta with a short, pointed ven-ral spine. (Fig. 301).

Female with narrow, lanceolate wings, the postmedial series reaching inner nargin three-fifths way out, normally obscure, or replaced by an obscure dark ine, irregular below. Fore wing with ground sometimes heavily dusted on an ochreous base. Hind wing white, shaded with gray toward margin. 35–48 mm.

August; June in the South.

Southern States; Illinois, Woods Hole, Massachusetts (dwarf).

3. **S. nitidellus** Dyar. Male superficially like that of *S. sordidellus*, but smaller; fore wing striate in two shades of fuscous; practically immaculate otherwise. 25–30 mm. Gnathos not emarginate, running into a short broad spine, half as long as the uncus; transatilla with two heavy backward-directed hooks, juxta with a large blunt spine swollen at the tip. (Fig. 302).

Female rather larger than male with narrow lanceolate wings, fuscous, or, rarely, clay-color, dusted with fuscous; with a blackish shade from base to apex. Postmedial line represented by an obscure shade, and a more distinct dot in the fold. Terminal dots weak. 35 mm. (*dispersellus* Robinson in part?).

Hampton, New Hampshire, to Texas.

S. clemensellus Robinson is unknown to me; as described, it must be closely similar to the preceding species, but perhaps with more distinct pale streaks on the veins. (Size and locality not given).

S. roscidellus Dyar, from the Gulf Strip, is also blackish with pale yellow veins, but the hind wing is almost wholly white. If I have it correctly determined the uncus is blunt, the spine on the gnathos almost as long as the uncus and well set off, the hook on the transatilla strong, and the spine on the juxta even in width for most of its length.

4. **S. unipunctellus** Robinson. Unicolorous dark fuscous, with a conspicuous black discal dot. Uncus shorter than spine of gnathos, which is even in width and arises from a deep notch in the gnathos. Spine of juxta very large and pointed; transatilla with a pair of large rounded lobes notched at the apex. The female appears to be dimorphic, as both fuscous and straw-yellow females have been taken with males of this appearance. (Fig. 303). Male 20 mm., female 25 mm.

Southern States.

S. tripunctellus Robinson. Powdery fuscous on a cream-colored base, show-ing two distinct blackish dots in the fold as well as the discal dot. Uncus short, blunt, and very broad; gnathos deeply emarginate, with a short tapering spine; transatilla bearing very large hooks, and spine of juxta swollen toward the tip. Female straw yellow, apparently indistinguishable from the yellow form of *S. unipunctellus*. 20–25 mm.

Southern States.

5. **S. melinellus** Clemens. Male straw yellow, with a faint grayish postmedial line extending down from apex, and fading out below; slightly narrower winged than *S. longirostrellus*, but not constantly distinguishable on superficial characters. A discal black dot and two dots in fold. Genitalia similar to those of *S. tripunctellus*, but uncus narrower toward the base, spine of gnathos stouter, hooks of transatilla hardly as large, and spine of juxta more swollen at the tip. (Fig. 304).

Female variable. Very narrow-winged. Ground normally light yellow, with a more or less distinct brown shade through the middle of the fore wing from the base to the apex 20–28 mm. Hind wing white in all forms; rarely, with black terminal points.

Typically, the longitudinal shade is moderately developed and diffuse; in variety **albocostellus** Fernald, it is defined on the upper side, setting off a clean-cut pale-yellow costal stripe from base to apex; in variety **dispersellus** Robinson, the ground is more or less dusted and suffused with fuscous; variety **pallulellus** Barnes and McDunnough is immaculate pale yellow; and variety **uniformellus** Dyar is fuscous, immaculate except for the blackish discal dot.

June to early August.

Northern States; Nova Scotia to Virginia. New York: Buffalo, Otto, Ithaca.

6. **S. longirostrellus** Clemens. Light straw yellow, more or less dusted and shaded with fuscous. A grayish postmedial dot in the fold; a blackish antemedial dot in the fold; and discal dot. Hind wing white. Uncus bluntly truncate, somewhat heart-shaped in posterior view, with a small nodule in place of a spine on its ventral side, transatilla bearing a pair of very large circular lobes; penis much more coarsely spinulated than in the rest of the genus, and containing a very heavy spine. Juxta apparently unarmed. Gnathos much modified, without a spine. (Fig. 305).

Female similar to male, the wings slightly narrower.

This species is easily distinguished by the blunt uncus in the male, which is almost always visible without dissection, and by broad blunt wings in the female. It is superficially close to the European *S. forficellus*, for which it has been commonly mistaken, but shows no resemblance in structure. I cannot tell by the description whether *S. amblyptepennis* Dyar is the same.

June and July.

Northern States; Canada (Montreal and perhaps Quebec) to Pennsylvania. New York: Newport, Newcomb, North Creek, Niagara Falls, Otto, Ithaca, Little Falls, Albany, New Windsor.

Subfamily **CHRYSAUGINÆ**

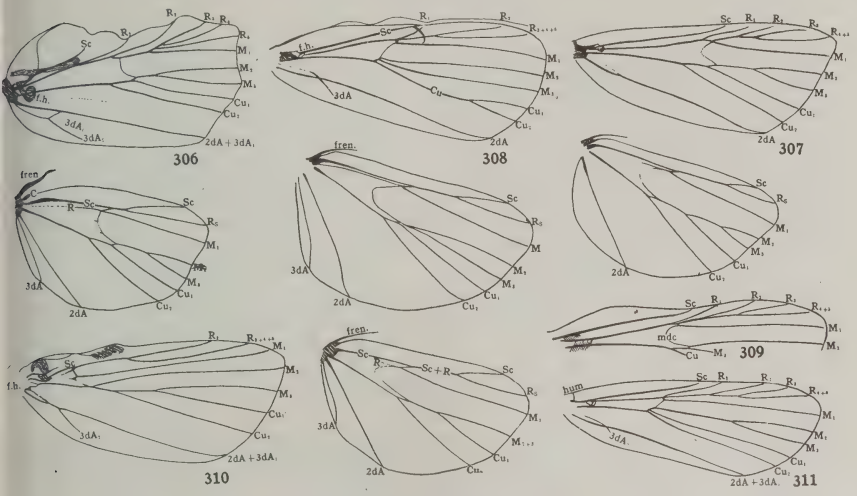
Antennæ normally laminate and fasciculate in male, rarely with any special modification. Palpi various, not strikingly dimorphic in the sexes, third segment normal, fully scaled; maxillary palpi completely absent; tongue developed. Ocelli most often present. Fore wing in female with R_{3-5} stalked, typically similar in male, but almost invariably more or less modified sexually; with distorted venation and costal lobes, tufts, etc.; often with a funnel-like structure at base of costa (fig. 306). Male retinaculum often modified into a loop. M_2 and M_3 free, stalked or united; **1st A** completely absent, **3d A** primitively forked, the upper branch becoming coincident with **2d A.** (In specialized forms **3d A** runs up into **2d A,** and then the lower fork separates again from **2d A** as a free spur.) Hind wing with no fringe on base of **Cu; Sc** and **R** anastomosing in our species; **1st A** completely lost, and frenulum often thickened and modified in male, multiple in female.

Larvæ normally leaf rollers, with uniordinal hooks in two transverse bands, on prolegs; adfrontal sclerites reaching vertex, and front, nearly to vertex; vii represented by a single seta on meso- and metathorax; ninth segment of abdomen with seta i about midway between ii and iii; with three well-separated and well-developed lateral setæ. Pupa not fully studied.

Key to the genera

1. Hind wing with all eight veins preserved.
   2. Fore wing with Cu_1 and Cu_2 stalked; M_2 and M_3 arising from cell separately (fig. 308) ..... 5. **Galasa.**
2. Fore wing with M_2 to Cu_2 all arising separately from cell ..... 4. **Tosale.**
2. Fore wing with M_2 and M_3 stalked.

3. Outer margin irregular, all veins present (fig. 306).....3. **Clydonopteron.**
3. Fore wing with even margins; 11 veins only (fig. 307).....6. **Arta.**
1. Hind wing with M_2 and M_3 completely fused; 7 veins.
2. Hind wing with **Sc** and **R** fused halfway to apex (fig. 310).
7. **Condylolomia.**
2. Hind wing with **Sc** and **R** completely fused.....8. **Polloccia.**



FIGS. 306–311. CHRYSAUGINÆ

306, *Clydonopteron tecomæ*, ♂, venation; **307,** *Arta statalis*, ♂, venation; **308,** *Galasa rubidana*, ♂, venation; **309,** *G. rubidana*, ♀ fore part of wing; **310,** *Condylolomia participialis*, ♂, venation; **311,** *Polloccia alticolalis*, ♂, venation of fore wing.

3. *CLYDONOPTERON* Riley

(*Salobrena*, in part)

Palpi oblique, as long as head and thorax together; second segment heavily tufted above and below, toward tip; third segment blade-like, long and heavily tufted above and below. Middle and hind tibiæ and metatarsi tufted. Fore wing (fig. 306) sexually dimorphic; male with a hollow cone at base of costa; retinaculum modified into a ring; costa with a deep triple notch at middle; apex subfalcate, and outer margin bent at M_3; wings very broad; **Sc** short, but well developed, free; R_1 running to the middle notch on the costa; R_2 arising near end of cell; R_3 to M_1 stalked, R_4 and R_5 the farthest; M_2 and M_3 stalked (unlike Salobrena); **3d A** strongly forked, the upper fork distinct and running into **2d A;** cell half as long as wing. Female without the cone; costal notches and falcations of apex weaker, venation much like that of the male. Hind wing in both sexes with **Sc** and **R** shortly fused, M_2 and M_3 stalked, otherwise normal; **1st A** obsolete. The genus is hardly distinct from the South American and Texas genus Salobrena.

1. **C. tecomæ** Riley. Fore wing with basal two-thirds mottled with yellow and brown, and shaded with orange; postmedial line a short fine white streak at

costa, then evenly and slightly concave, slightly paler and fine, to inner margin defined by a heavy dark shade before and a fine line beyond it. Wing beyond postmedial line more nearly even purplish fuscous. Hind wing dark. (**H 48**:11.

Larva a leaf roller on trumpet creeper.

District of Columbia, Illinois, Missouri, and south.

4. *TOSALE* Walker

(*Siparocera* Grote)

Palpi obliquely upturned to middle of front, short; tibiæ tufted as in Clydonopteron, but the hind tibiæ less heavily so; fore wing of male with a very large hollow cone at base of costa, retinaculum ring-like, and frenulum thickened and modified, the outer margin nearly even and apex not falcate; R_2 stalked in female, free in male; M_1 from cell; M_2 and M_3 connate; **3d A** swinging up to meet **2d A** and obliterating **3d** A_1. Hind wing with **Sc** and **R** shortly anastomosing; all the other veins free. Female similar, without the cone and modified frenulum and retinaculum. *In T. oviplagalis* the male has a large oval patch of black sex scales on upper side of hind wing and one on under side of fore wing.

1. **T. oviplagalis** Walker. Antemedial space yellow-brown to olive, bounded by a white, evenly excurved antemedial line; basal sixth pinkish, the rest of the wing dull light brown; median area paler and grayer, especially toward costa; postmedial line twice as far from apex as from anal angle, convex in the middle and concave toward the margins; even. Some gray shading before postmedial line and some brown beyond it toward costa. Hind wing fuscous, with a large black patch in male. 16 mm. (*S. nobilis* Grote, *Asopia anthœcioides* Grote.) (**H 48**:33).

May to July.

New York to Illinois, and south to South America. New York: Ithaca, Long Island.

5. *GALASA* Walker

(*Cordylopeza* Zeller)

Palpi rather short, beaklike, second segment tufted on upper side. Middle tibiæ and metatarsi very heavily tufted with black scales; hind metatarsi very heavily tufted, and tibiæ and second joint of tarsi more lightly; fore wing of male (fig. 308) without a cone at base of costa (a rudiment visible on bleaching), retinaculum large but normal, buried in loose scaling; **Sc** weak, normal; R_1 and R_2 lost (Hampson figures R_1 as present, but I cannot find it), cell two-fifths length of wing, M_1 free; M_2 and M_3 connate or shortly separate; Cu_1 and Cu_2 long-stalked; **2d A** and **3d A** anastomosing at a point, obliterating **3d** A_1. Hind wing with frenulum not modified; **Sc** and **R** anastomosing, lower part of discocellular vein closely parallel to lower edge of cell, and M_2 and M_3 more or less distinctly stalked. Fore wing with two shallow notches, with a curved pencil of hair (concealed by the scaling) curving down across the surface of the wing from the second one. Female with palpi longer, curved down at tip, tibiæ and tarsi less heavily tufted; fore wing (fig. 309) with a single broad shallow notch; R_1 arising near the tip of the cell; R_2 stalked; R_3 lost; **3d A** connected to **2d A** by a short section of **3d** A_1; frenulum triple.

1. **G. nigrinodis** Zeller. Fore wing orange-red, at base, dull crimson outwardly; the concave part of costa finely gray-edged; antemedial and postmedial lines white, normally defined with fuscous, sometimes distinct at costa only. Antemedial line waved, postmedial finely dentate. Hind wing dirty white, shaded with fuscous, often with a distinct postmedial gray shade. 15–18 mm. (*rubidana* auct., not Walker).

June and July; September.

New Hampshire and Ontario to Illinois, Missouri, and south. New York: ffalo, Ithaca, Big Indian Valley, Schenectady, Nassau, Highland, New Windsor, orida, Katonah, New York City.

6. *ARTA* Grote

(*Heliades* Ragonot)

Palpi quite short and porrect or drooping; front smooth-scaled, tibiæ practically nooth-scaled; fore wing (fig. 307) triangular, and without striking sex modifications; Sc long, normal, reaching well beyond middle of costa; one branch of R ee, three stalked, one lost; M_1 free; M_2 and M_3 stalked; **2d A** and **3d A** becoming ncident. Hind wing with Sc and R anastomosing more than half way from cell apex; Cu_1 shortly stalked with M_{2+3}, and **1st A** lost.

1. **A. statalis** Grote. Light pinkish brown, with a fine straight pale line at ree-sevenths, and a similar slightly waved one at five-sevenths; hind wing ayish, with traces of postmedial line. 15 mm.

The moth flies about Myrica in July and August, and is locally common in assachusetts. The southern distribution is uncertain on account of confusion ith *A. olivalis* and other related species.

New Hampshire to Illinois and south. "New York" (Grote).

2. **A. olivalis** Grote. Light olivaceous, with faint white lines. 14 mm.

July and August.

Maryland; North Carolina; Texas.

7. *CONDYLOLOMIA* Grote

Front slightly tufted; legs with thick scaling but without definite tufts; palpi hort, porrect, and hairy below. Fore wing (fig. 310) narrower than in Arta; male, with a small portion folded over a third way out on costa, bearing a blacksh hair-tuft, and with a rudiment of a basal cone; retinaculum heavy, frenulum ormal; fore wing with cell minute, one-fourth length of wing, very short toward osta; R_1 lost; R_2 running into Sc, which bifurcates, both branches running to osta; M_1 widely separated from R_{3+5}; M_2 from lower angle of cell; Cu_2 shortly talked with M_3+Cu_1; **3d A** fused for a short distance with **2d A**; with a strong ree tip. Hind wing with Sc and R moderately anastomosing; M_1 arising from he free sector of R, Cu_1 short-stalked with M_{2+3}. Female with R_1 becoming coident with Sc; the other three radials stalked; one lost; M_2 and M_3 long-stalked.

1. **C. participialis** Grote. Pale grayish olivaceous, darker toward the margin; vith a diffuse darker antemedial line, and a darker, followed by a pale luteous, ostmedial line, both slightly irregular. Hind wing darker gray. 12–15 mm.

Moth flying over Myrica in July and August.

Massachusetts to Pennsylvania and Illinois. New York: Rock City (Cattaaugus County), Ithaca, Katonah.

8. *POLLOCCIA* Dyar

Palpi much longer than head, beaklike, drooping, legs slender. Wings (fig. 311) ot much modified sexually; fore wing with Sc free, one R from tip of cell, three talked and one lost; M_1 separate; M_2 and M_3 stalked; Cu_1 and Cu_2 approximate rom lower angle of cell; cell one-third length of wing. **3d A** shortly anastomosing with **2d A**, with free tip. Hind wing with Sc and R completely fused, M_1 moderately stalked with them; Cu_1 and Cu_2 free; **1st A** preserved.

1. **P. alticolalis** Dyar. Clay-color, more or less suffused with pinkish, and shaded with light gray, partly defining the ante- and postmedial lines; antemedial line

dentate, black, preceded with luteous, and rather broad at costa, interrupted b a fovea in cell of male; postmedial line blackish, followed by luteous; perpen dicular at costa, then strongly excurved opposite cell, and sinuate below. Hin wing pale. 13 mm.

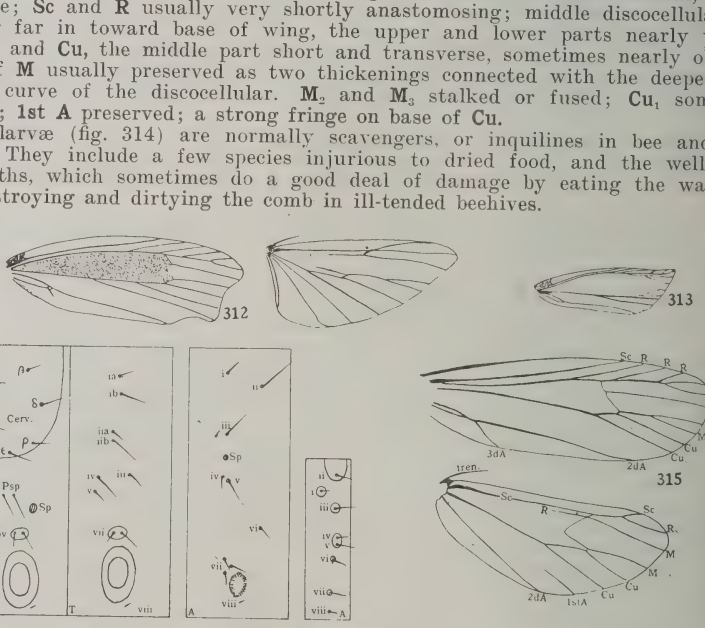
July and August.

New Hampshire to Virginia and northwestern Ontario. New York: Jamestow (McElhose, Dyar det.), Ithaca (W. T. M. F.).

Subfamily GALLERIINÆ

Male antennæ simple, not modified; ocelli always absent, maxillary palpi obsolet in male; often distinct but small, in female; tongue very weak or obsolete. Bod normally stout, with deep vestiture. Palpi sexually dimorphic, except in a few primitive exotic species, upturned in male, rather short, with third segment mor or less rudimentary; upturned or porrect in female, and normally developed, some times long and beaklike. Fore wing with R_3 to R_5 stalked, **3d A** forked, with th upper fork joining **2d A**, or simple (the lower fork lost) and becoming coinci dent with **2d A**. **1st A** lost. Hind wing with male frenulum normal, female multiple; **Sc** and **R** usually very shortly anastomosing; middle discocellular vein curving far in toward base of wing, the upper and lower parts nearly parallel with **R** and **Cu**, the middle part short and transverse, sometimes nearly obsolete. Base of **M** usually preserved as two thickenings connected with the deepest part of the curve of the discocellular. M_2 and M_3 stalked or fused; Cu_1 sometimes stalked; **1st A** preserved; a strong fringe on base of **Cu**.

The larvæ (fig. 314) are normally scavengers, or inquilines in bee and wasp nests. They include a few species injurious to dried food, and the well-known bee moths, which sometimes do a good deal of damage by eating the wax, etc., and destroying and dirtying the comb in ill-tended beehives.



FIGS. 312–315. GALLERIINÆ AND MACROTHECINÆ

312, *Galleria mellonella*, ♂, venation and sex patch; **313**, *Aphomia sociella*, ♂, venation of fore wing; **314**, *Galleria mellonella*, seta map of larva; **315**, *Macrotheca flexilinealis*, venation

Prolegs with uni- or biordinal hooks, in a complete ellipse; prespiracular setæ of prothorax and **iv** and **v** of abdomn in a horizontal line; **vii** of meso- and meta-thorax of two setæ; **i** to **iii** of ninth segment of abdomen forming an equilateral

iangle, with iii directly below ii. Pupæ with tongue short, and pilifers rudimen-ry, maxillary palpi present, small; dorsum of body with a prominent median dge, and segments covered with small spines.

The subfamily is a small one, widely separated from the other Pyralids (except ıe Macrothecinæ). Our few genera are closely related and do not fully represent ıe group. It has been suggested that Linnæus' name "Tinea" should be applied ı this group, as the bee moth was included in his genus, and was the form best ıown as "Tinea" by the ancients; but I have preferred to keep to familiar usage, ıpecially as Tinea was regularly used in an inclusive sense for a variety of stored ıod pests and clothes moths.

Key to the genera

1. Hind wing with all veins (fig. 312).....9. **Galleria.**
1. M_2 lost (fused with M_3).
2. Fore wing with all veins; R_2 from cell.
3. Cell about two-thirds length of wing in both sexes; M_2 and M_3 stalked. 10. **Melissoblaptes.**
3. Cell nearly reaching outer margin in male; with M_2 and M_3 well separated and often rudimentary; in female, M_2 and M_3 connate from lower angle of cell.
4. Cell in male almost reaching outer margin (fig. 313); base of costa with a pocket below; female with palpi projecting two and a half times the width of the eye.....12. **Aphomia.**
4. Cell in male not quite so long; pocket located near middle of wing and associated with a hyaline spot; palpi of female projecting one and one-half times the width of the eye.....11. **Paralispa.**
2. Fore wing with one radial wanting; M_2 and M_3 separate; no frontal tuft; hind wings acute, with longer fringe; with discocellular vein barely extending in to middle of cell; fore wing in male with cell almost reaching outer margin.....13. **Achroia.**
2. Fore wing with a dorsal vein lost; no sex scaling in cell.....(12) **Corcyra.**

9. *GALLERIA* Fabricius

Antennæ simple with a scale-tuft on scape in both sexes; palpi of male upturned, ninute, hidden in frontal tuft; palpi of female forming a short beak, with third ıegment short; fore wing (fig. 312) in male with a slight thickening at base of ıosta, cell thickened and with sex scaling below, three-fourths length of wing; niddle discocellular distinct and angled in; M_1 and M_2 well-developed, free; R_2 ree; apex bluntly subfalcate (at R_5 and M_1); outer margin produced at Cu_2, ıoncave above and below; tip of **3d A** free. Hind wing with M_2 and M_3 long-ıtalked; Cu_1 free; discocellular extending more than half way to base of wing. Female without thickenings or sex scaling, the tooth on Cu_2 and concavity of the ıuter margin less distinct; cell rather broader and shorter. A row of small raised ıufts in the fold.

1. **G. mellonella** Linnæus. Dull gray, strigose; inner margin, below fold, yellower; tufts on fold often blackish; postmedial line represented by a series of ıbscure blackish bars. Hind wing fuscous, pale at base. 25–35 mm., female larger. (*Tinea* Linnaeus; *Tortrix cereana* Linnaeus.) (**H** p. 406, f. 226.)

The larva is a serious pest in ill-kept beehives, eating and webbing up the comb; also a scavenger in waste wax, etc.

World-wide in distribution. New York: Fentons (Lewis County), Vicinity of Buffalo, Ithaca, New Baltimore, Flatbush. A common species wherever looked for.

10. *MELISSOBLAPTES* Zeller

Palpi much as in Galleria; scape large, but smooth-scaled; fore wing with a larg costal pocket in male, but cell not enlarged; R_1 and R_2 free, R_3 to R_5 stalked; i and R_5 the farthest; M_1 arising distinctly below angle of cell; M_2 and M_3 in ot species connate, typically stalked; Cu_2 arising well toward base. Free tip of 3d lost. Hind wing with cell extremely short in middle, M_{2+3} stalked with Cu_1. Th larva lives in a sand tube at the surface of the ground. The normal food i unknown, but it will eat dried insects, etc.

1. **M. fuscolimbella** Ragonot. Whitish, shaded with brown; marginal are darker brown; lines fine, dark, defined, the antemedial line edged before, and post medial line beyond, with pale; antemedial line obtusely angled below cell; post medial dentate; discal spots fusing into an irregular triangle. Hind wing fuscous dark at apex. Female unknown. **24 mm.**

North America.

11. *PARALISPA* Butler

(*Paralipsa,* by misprint)

Similar to Melissoblaptes; scape somewhat tufted; palpi moderate, porrect about as long as the large frontal tuft. Fore wing rounded-lanceolate, with con vex costa; cell long, broad in male, and extended out below well toward margin scaled as in Galleria; large but normal in female.

This genus is hardly distinct from the preceding and following, which are com bined with it by Hampson. The three nominal species are not well known and may be only varieties.

1. **P. terrenella** Zeller. Cell two-thirds length of wing (♀). Brownish gray somewhat streaky; with a large blackish basal dash, more than one-third length of wing, and stronger in the male; a fine irregular outer line, deeply rounded out on middle half, the wing shaded with brown before it, and grayer beyond. Reni form represented by a black stria. Hind wing fuscous in male, pale in female 28 mm. (*Melissoblaptes furellus* Zeller.)

End of June to August.

New York; Georgia. New York: Ithaca, vicinity of Albany.

2. **P. decorella** Hulst. Similar to *P. terrenella;* described as having a distinct dentate antemedial line, but postmedial line obsolete. 28 mm.

Unknown to me.

Southern Ontario. New York: Buffalo (Grote).

3. **P. fulminalis** Zeller. A more contrasty form than the two preceding, the markings as in *terrenella,* but strong on a pale luteous ground; more or less emphasized with dark gray; the cell often filled out with a dark gray blotch, and outer margin more or less shaded with dark gray. Hind wing darker and grayer. ♂ **22 mm.**

Maryland to Pennsylvania.

12. *APHOMIA* Hübner

Male palpi as in Galleria, those of female rather long, porrect. Tongue and maxillary palpi relatively well developed. Fore wing of male (fig. 313) with medials and cubitals all well separated; the cell extending almost to margin at M_2 and M_3, nearly obliterating them. Cell very broad. Hind wing very broad, trapezoidal. Otherwise like Melissoblaptes.

1. **A. sociella** Linnæus. Male white to pale gray, lightly marked with russet;

male pale gray shaded with olivaceous and russet; the lines strongly dentate, ose together, black when distinct; discal dots strong and black, or lost in a lackish shade; hind wing gray in both sexes. 30 mm., the female usually larger. *colonella* Linnæus.)

Larva in nests of bumblebees and wasps, but not with honeybees; more rarely n dried stores, cotton, books, borings of wood-borers, etc.

Nova Scotia; Massachusetts; probably generally distributed; introduced from urope.

Corcyra cephalonica Stainton (*Tineopsis theobromæ* Dyar) is a common European ried-food pest, to be expected in our territory.

13. *ACHROIA* Hübner

Easily distinguished by the want of the frontal tuft. Antennæ long, with a cale-tooth on scape; palpi minute in male, shorter than eye in female; legs lender. Fore wing of male oval; broadest toward base; 11 veins, one radial lost, ll the others free; R_1 arising opposite Cu_2, Cu_1 as near Cu_2 as M_3, M_2 well separated. Female with fore wing more evenly elliptical, with M_2 and M_3 stalked; hind ving with M_{2+3} stalked with Cu_1.

1. **A. grisella** Fabricius (The lesser bee moth). Pale gray-brown; the head light ellow, contrasting; immaculate. Hind wings pale, with gray fringe. ♂ 17, ♀ 21 mm.

Caterpillar with the habits of *G. mellonella* and associated with it. It will also eat dried apples, raisins, crude sugar, and apparently also dried insects.

World-wide in distribution.

Subfamily MACROTHECINÆ

Near the Gallerinæ, but slender species with close-scaled bodies. Palpi in male very short, with a heavy tuft on second segment above and below; third segment very short, naked, and turned inward; palpi in female very long and beak-like; maxillary palpi and tongue absent. Fore wing (fig. 315) narrow and thin, with arched costa and rounded apex and outer margin. Macrotheca has R_2 shortly stalked with R_{3-5}, R_4 and R_5 the farthest; M_1 widely separated; M_2 and M_3 stalked; cell about two-thirds length of wing; 1st A not chitinized, but with a wide space in its position; 3d A anastomosing with 2d A but with a strong free tip, reaching margin. Hind wing with cell extremely large, two-thirds length of wing; Sc and R strongly anastomosing; the base of R reduced to a short spur; mdcv, sharply right angled in middle, with a single rudiment of the base of M running to its angle; M_2 lost; M_3 and Cu_1 nearly connate; fringe on Cu obsolete; anal region reduced, especially toward the base, and the veins very weak.

The only known larva of the group is predacious on scale insects.

14. *MACROTHECA* Ragonot

1. **M. unipuncta** Dyar. Powdery gray; antemedial line far out, sometimes obsolete, black and dentate when distinct; postmedial obscure, irregularly sinuous, followed by an imperfect second line. Discal dot a large black irregular spot. Hind wing fuscous in male; female not seen.

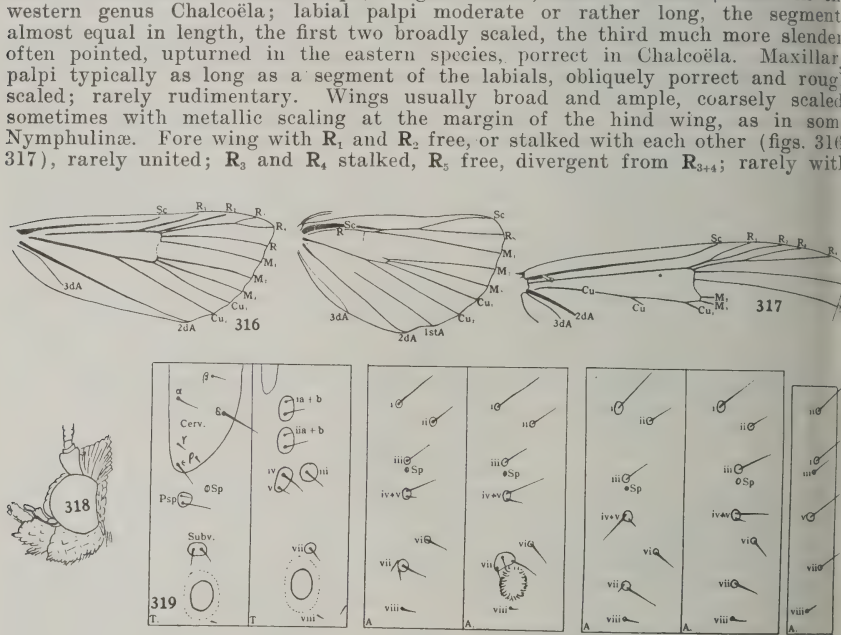
July.

Western Pennsylvania. Apparently a form of this species occurs in Arkansas, but its discal dot is small. It is not known from the intervening territory.

Subfamily GLAPHYRIINÆ

(Homophysidæ; Pyraustinæ; Crambinæ, in part)

Head smooth (fig. 318); ocelli well developed; antennæ of male not modified with a rather small smooth scape; tongue normal, scaled at base (absent in the western genus Chalcoëla; labial palpi moderate or rather long, the segments almost equal in length, the first two broadly scaled, the third much more slender, often pointed, upturned in the eastern species, porrect in Chalcoëla. Maxillary palpi typically as long as a segment of the labials, obliquely porrect and rough scaled; rarely rudimentary. Wings usually broad and ample, coarsely scaled, sometimes with metallic scaling at the margin of the hind wing, as in some Nymphulinæ. Fore wing with R_1 and R_2 free, or stalked with each other (figs. 316, 317), rarely united; R_3 and R_4 stalked, R_5 free, divergent from R_{3+4}; rarely with



FIGS. 316–319. GLAPHYRIINÆ

316, *Lipocosma fuliginosalis*, venation; **317**, *Glaphyria glaphyralis*, venation of costal part of fore wing; **318**, *Dicymolomia julianalis*, head; **319**, *D. julianalis*, seta map of larva (ex coll. Claassen)

R_2 stalked with R_{3+4}; **1st A** lost; **3d A** free, weak. Hind wing ample, with a large broad cell; **Sc** and **R** strongly anastomosing; M_1 connate with **R**; M_2 and M_3 closely approximate or shortly stalked; middle discocellular long and moderately bent, not tubular; frenulum of female multiple. Upper side of hind wing with a more or less defined fringe of long hair just below **Cu**, ending in a larger or smaller number of spatulate hairs or scales in the fold, near or below end of cell; a similar series of hairs on **2d A**, also usually ending in a group of scales.

The spatulate hairs or scales are more or less deciduous, but distinct in fresh specimens of all species; the characteristic palpi will distinguish them from the most similar Pyraustinæ, the broad rounded wings from all our Nymphulinæ, to which they are probably most closely related. The Crambinæ and the Ancylolomiinæ are not, in fact, close relatives, and all the species known to me may be distinguished by the open cell or widely spaced **R** and **M**, of the hind wing. (Larva, fig. 319.)

Key to the genera

1. Fore wing with R_1 and R_2 stalked, rarely united (fig. 317); no metallic scaling ..... 15. **Glaphyria.**
1. Fore wing with R_2 free from R_1 (fig. 316), rarely short-stalked with R_{3+4}.
2. With metallic scaling on margin of hind wing; maxillary palpi as long as third segment of labials ..... 17. **Dicymolomia.**
2. No metallic scaling; maxillary palpi shorter, or rudimentary. **16. Lipocosma.**

15. *GLAPHYRIA* Hübner

(*Homophysa* Guenée)

Characters of the subfamily. Palpi with slight projecting angles formed by the estiture of the first two joints, third joint obliquely upturned. Hind wing with M_2 and M_3 approximate. Fore wing with apex rounded or marked. Maxillary alpi always moderate in size, rough-scaled, and porrect. Fore wings with a ellow or yellowish ground color, with two white transverse lines; the antemedial ine usually waved, the postmedial one denticulate, and both normally finely lark-edged.

Key to the species

1. Antemedial space below costa, at least, and sometimes whole disc brown or fuscous.
2. Basal sixth contrastingly pale ..... 5. *fulminalis.*
2. Basal sixth concolorous with antemedial space, or slightly paler at extreme base ..... 6. *peremptalis.*
1. Ground color ranging from straw to ochre yellow; without a darker antemedial area.
2. Outer half of fringe pure white ..... 4. *lentiflualis.*
2. Outer half of fringe only slightly paler.
3. Fringe mixed fuscous and white, appearing striate in perfectly fresh specimens ..... 3. *psychicalis.*
3. Fringe evenly, or nearly evenly, ochre yellow, concolorous with wing or somewhat darker ..... 2. *sesquistrialis.*
3. Fringe cream-white ..... 1. *glaphyralis.*

1. **G. glaphyralis** Guenée. Lemon yellow, more or less marked with cream-white; sometimes cream-white with the yellow only defining the markings. Antemedial line waved; postmedial sinuous and denticulate; white terminal dots. Fringe somewhat paler. Sometimes lightly shaded with pale brown. Hind wing similar on the dorsal part, toward the costa shading into cream-white. 15–18 mm.

July and August. Florida specimens are usually bright yellow; northern ones mostly cream-white.

New York to Illinois and southward. New York: Otto, Ithaca.

2. **G. sesquistrialis** Hübner. Ochre-yellow; duller than *G. glaphyralis*, the lines similar, distinctly defined with light brown, and the ground somewhat shaded with light brown, but without whitish shades. A distinct broken black terminal line, preceded by white dots; fringe ochre to light brown. 15–18 mm.

June to August; October.

Massachusetts to Illinois and south and west. New York: Ulster County.

3. **G. psychicalis** Hulst. Bright ochre yellow; lines very fine, normal, sometimes partly defined with brown, and more or less broken; more wavy than in the last two species. Terminal dots strong, black and white; fringe mixed fuscous and white. Hind wing frequently more or less suffused with light fuscous. 12 mm.

July and August.

Massachusetts to Ontario, Illinois, and Florida.

4. **G. lentiflualis** Zeller. Ochre; antemedial line obscure, not dentate in the fold; postmedial line rather evenly sinuate, only slightly paler, and preceded by a darker

line; terminal dots obscure; fringe fuscous on basal half, white-tipped. Hind wing similar toward margin, pale at base. 15 mm.

June. Perhaps a synonym of *G. invisalis* Guenée, of South America.

Central Illinois; North Carolina; Iowa; Texas.

5. **G. fulminalis** Lederer. Disc of wings yellowish to dark umber brown. Base of wings contrasting, pale yellow, brighter than in *L. fuliginosalis*, the paler area extending out to the antemedial line along the costa. Outer margin yellow to postmedial line, except at anal angle. Costal edge sometimes wholly yellow. Lines normal, white, defined with brown. Hind wing pale, with a brown patch crossed by a white line toward the inner margin. 10–15 mm.

Late June and July.

Connecticut to Illinois, Florida, and Texas. "New York" (Grote.)

I have examined a specimen in which the radial veins were reduced to three: R_{1+2}, R_{3+4} and R_5.

6. **G. peremptalis** Grote. Similar to *G. fulminalis*, the fuscous area extending to costa, almost to base, and diffusely shading into the lighter brown outer third. 12 mm.

July.

Western Pennsylvania to North Carolina and Texas.

16. *LIPOCOSMA* Lederer

(With *Symphysa* Hampson, in part; *Egesta* Ragonot)

Intermediate between Glaphyria and Dicymolomia. Maxillary palpi moderate to rudimentary; labials oblique, with the three segments equal, or with the first two segments decidedly longer; closely upturned beyond the vertex. Tongue and wing form as in Glaphyria; R_2 well separated from R_1 (fig. 316), sometimes stalked with R_3. Spatulate scale-tufts on hind wing well developed. Ocellus larger than in Nymphula.

Key to the species

1. Ground even fuscous brown.
   2. Reniform a large white lunule.....1. ***reniculalis.***
   2. Reniform obsolete .....2. ***eripalis.***
1. Base white; apex at least whitish.
   2. Median area wholly white.....3. ***adelalis.***
   2. Median area yellow to fuscous, between cell and inner margin....4. ***sicalis.***
   2. Median area wholly fuscous.....5. ***fuliginosalis.***

1. **L. reniculalis** Zeller. Powdery dull brown; antemedial line dentate, postmedial sinuous, white, defined with dark brown; a large white discal lunule, with a small white spot below it in the fold; terminal line black, broken, with some white before it. Fringe concolorous. Hind wing similar, becoming whitish at costa. Palpi closely upturned, maxillary palpi obsolete; spatulate tufts on hind wing weak. 15 mm. (*Homophysa* Hampson, *Symphysa* Hulst.)

June and August.

Central Illinois and North Carolina to Texas; a race in Arizona.

2. **L. eripalis** Grote. Similar to *L. reniculalis*, with a slight violaceous tint when fresh; lines finer, antemedial extended far out in cell, and more dentate. No reniform spot or dot below it. Hind wing with only part of outer line visible. Fringes with a strong white line in outer part. Palpi obliquely porrect, rough; maxillary palpi rough and well developed; raised tufts on hind wing slight. Front more oblique than usual. 18 mm. (*Symphysa* Hampson; *Egesta* Barnes and McDunnough.)

Late June.

Virginia to central Illinois and Missouri, south and west.

3. **L. adelalis** Kearfott. Raised tufts of spatulate scales on hind wing large and black; palpi rough, oblique, beak-like, with large maxillary palpi. Ground white.

ore wing with obscure dark ante- and postmedial lines, running about as usual; ight gray shades before antemedial line and beyond postmedial. Discal dot ack, strong; one or two black terminal dots near apex. Hind wing white, with small gray subterminal shade near the black tufts. 15 mm. (*Symphysa earfott.*)

Late July and early August. Larva in a flat oblong case; constricted near each id; on lichens.

Anglesea, New Jersey.

4. **L. sicalis** Walker. Palpi oblique, maxillary palpi very small; tufts strong. ore wing cream-white, shaded with clay color in outer part, leaving some white ong postmedial line and on margin; medial area largely clay-color, more or less iffused with fuscous, but leaving the region beyond the cell pale. Lines fine and ark; postmedial line, when complete, with a long tooth in the fold running up ward the lower angle of the cell. Hind wing similar, with a distinct black post- iedial line; median area dusted with black, usually leaving a distinct white discal ot. 18 mm.

May to July.

New York to Illinois, Iowa, and Texas. "New York" (American Museum of Natural History.)

5. **L. fuliginosalis** Fernald. Maxillary palpi distinct, labial palpi oblique; tufts n hind wing strong, whitish, heavily shaded with fuscous, leaving only the base half- ray out to the antemedial line, apex, and sometimes outer part of costa and outer nargin, white; lines blackish as before, usually with broken terminal line. Hind ving normally with blackish below the end of the cell to the inner margin, and a narginal shade toward inner margin; sometimes mostly fuscous. 12 mm.

June and September.

Southern New Hampshire to Michigan, south to New Jersey and Missouri. New York: Otto.

17. *DICYMOLOMIA* Zeller

Venation as in Lipocosma; tufts on upper side of hind wing strong; labial palpi ipturned (fig. 318), with more or less rough hair, as in Lipocosma; maxillary palpi decidedly longer than third joint of labials, rough-scaled, and truncate. Hind ving more or less distinctly notched opposite cell, with brilliant metallic scaling along outer margin below the notch.

Larva (fig. 319) with setæ vii on meso- and metathorax single; prolegs with crotchets biordinal; in a circle, shortly open on the outer side. Seta v of abdomen directly above iv; the tubercles much reduced; a single lateral seta on segment 9.

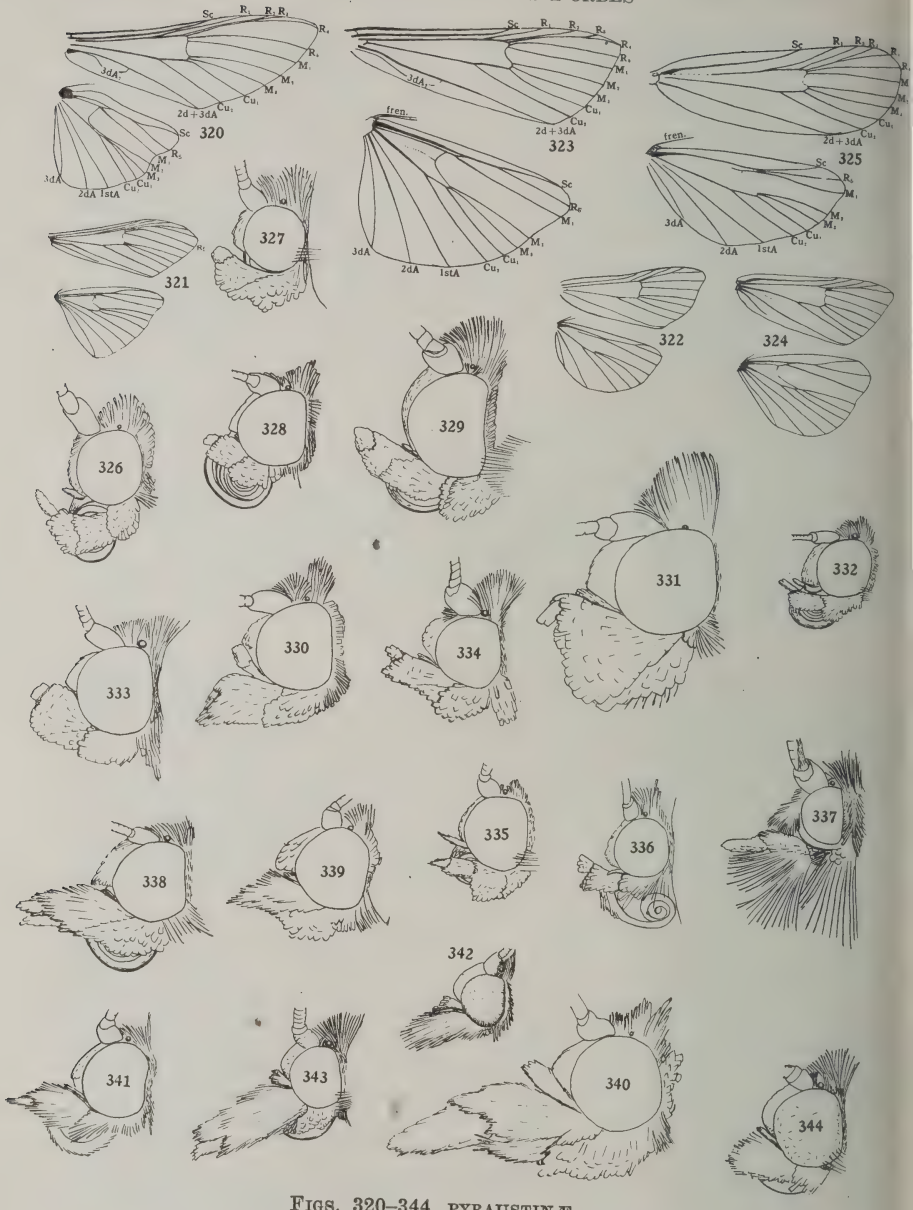
This genus, and the related western Chalcoëla, have generally been put in the Crambinæ, but they are very closely related to Glaphyria and Lipocosma in every way. The larva also appears to be near that of the Pyraustinæ, but wholly unlike the Crambinæ.

Key to the species

A single row of black dots on outer margin of hind wing.....1. *julianalis.*
Two rows of alternate black dots.....2. *pegasalis.*

1. **D. julianalis** Walker. Light brown, shading into bright yellow at the base; median area white, dusted and suffused with fuscous brown; lines white, rather obscure, except as a definition of the median area; running as in Glaphyria; discal lunule white, followed by black dusting; some white before terminal line; fringe brown. Hind wing similar on inner half; median area dusted with black; with two strong raised tufts; the basal and costal portion shading into white. A brilliant lead-colored marginal line below the notch opposite the cell, cut by four black dots in interspaces. 15–18 mm. (*decora* Zeller.)

Late June and August. Larva in cat-tail heads; stout and unicolorous whitish, with dark head.



FIGS. 320–344. PYRAUSTINÆ
(See bottom of opposite page for descriptions)

Connecticut to Illinois, Florida, and Texas. New York: Portage, Ithaca, New Windsor, Riverdale, Bronxville.

2. **D. pegasalis** Walker. Base and outer margin more evenly chocolate brown; dorsal half of hind wing more evenly dusted with black, the tufts weaker. Marginal line cut by five or six black spots, and with a series of black dots on the veins, along its inner edge. 20 mm. (*principialis* Walker.)

July and August.

Central Illinois to North Carolina and south.

Subfamily PYRAUSTINÆ

Head smooth; ocelli present. Male antennæ normal with a few exceptions (the most striking ones in our fauna are Pilocrocis and Desmia). Front very often oblique (fig. 344, etc.), extending out below, in a few genera conical (fig. 339), and in some western and exotic forms with a specialized process. Tongue strong, scaled; maxillary palpi small but distinct, rarely if ever as long as second segment of labial palpi. Labial palpi of various shapes (figs. 326 to 344), usually with short third joint. A distinct row of scales between antennal socket and eye. Hind tibiæ sometimes with the outer spurs in the male rudimentary. Fore wing usually triangular, ample, rarely as bluntly rounded as in the Glaphyriinæ, narrow in Nomophila (fig. 323). Hind wing of moderate size, ample in Nomophila. Fore wing with R_1 and R_2 free, R_3 and R_4 stalked except in a couple of exotic genera; R_5 free, often approximate to R_{3+4} at the base, M_1 approximate to R_5. Hind wing with Sc and R anastomosing except in some specimens of Loxostegopsis (fig. 325) and a few exotic forms; M_1 arising from upper angle of cell; Cu with a very slight fringe at base, or none; frenulum of female multiple. All veins present in both wings.

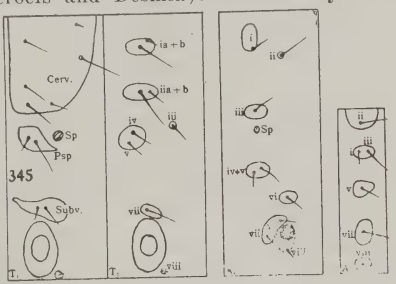


FIG. 345. HYMENIA PERSPECTALIS
Seta map of larva

This is the largest and the most varied subfamily of Pyralididæ, but very few

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FIGS. 320–344 PYRAUSTINÆ

(See opposite page for figures)

320, *Desmia funeralis*, ♂, venation; **321**, *Glyphodes unionalis* (Europe), venation; **322**, *Blepharomastix stenialis*, venation; **323**, *Nomophila noctuella*, venation; **324**, *Pyrausta insequalis*, venation; **325**, *Loxostegopsis polle*, venation; **326**, *Hymenia fascialis*, side view of head; **327**, *Desmia funeralis*, side view of head; **328**, *Samea ecclesialis*, side view of head; **329**, *Pantographa limata*, side view of head; **330**, *Glyphodes quadristigmalis*, side view of head; **331**, *G. hyalinata*, side view of head; **332**, *Blepharomastix stenialis*, side view of head; **333**, *Pilocrocis ramentalis*, side view of head; **334**, *Diastichtis argyralis*, side view of head; **335**, *Evergestis straminalis*, side view of head; **336**, *Hellula undalis*, side view of head; **337**, *Titanio pollinalis*, side view of head; **338**, *Nomophila noctuella*, side view of head; **339**, *Loxostege obliteralis*, side view of head; **340**, *Tholeria reversalis*, side view of head; **341**, *Crocidophora serratissimalis*, side view of head; **342**, *Autocosmia* (?) *helianthales*, side view of head; **343**, *Phlyctænia ferrugalis*, side view of head; **344**, *Pyrausta pertextalis*, seta map of larva.

of the genera show striking structural characters. Superficially, the species ofte resemble Noctuidæ, Geometridæ, or even Pterophoridæ; but can generally be reco nized by their thinner, more ample hind wings, besides the different venation. Th venational characters used in this key are somewhat unstable, and the palp characters are often almost intangible, so a certain proportion of specimens ma run to the wrong genus. The "oblique" front is less convex than the "rounded one, and gets steadily farther from the eye clear to its lower edge; the "rounded front is strongly convex, and its lower half, at least, parallel to the curvature the eye. (Larva, fig. 345.)

Key to the genera

1. Labial palpi (figs. 332, 348) obliquely upturned, with segments sharply se off, the third segment nearly as long as the second and closely scaled maxillary palpi rough-scaled, with truncate tip, almost as long as secon joint of labial palpi and much longer than third.
2. Tongue very strong, much wider than palpi..21. **Blepharomastix** (*stenialis*)
2. Tongue weak, much narrower than palpi..(50. **Nymphula** — Nymphulinæ)
1. Labial palpi with third joint usually smaller, sometimes very small, attache to upper side of end of second joint; sometimes lying along the tuft whe the second joint is tufted, but never forming the end of the tuft; maxillar palpus smaller, not broadened at end, sometimes minute (fig. 326).
2. Third segment of palpus long, upturned, and pointed, almost as long a second .....18. **Hymenia**
2. Third segment of palpus short, lying along upper side of tuft on secon (fig. 334).
3. Maxillary palpus reaching to tip of labial on upper side (though not t the tip of its tuft) and more or less truncate.....**21. Blepharomastix.**[3]
3. Maxillary palpus shorter.
4. Third segment of palpus well set off, truncate, and broadened or wit a triangular tuft at tip (fig. 334); R_5 well separated from R_{3+4}. **20. Diastichtis**
4. Third segment of palpus not broadened at tip.
5. Second segment of palpus, with its vestiture, almost as large as eye in side view (fig. 330, 331).....27. **Eudioptis**, 28. **Condylorrhiza**
5. Second segment of palpus rarely half as large as eye in side view.
6. Fore wing with R_5 approximate to stem of R_{3+4} at origin; palpus with second segment rounded, third well set off at its tip.
7. Male with a tuft at a notch at middle of antennæ, and with distorted venation in hind wing; both sexes with **Cu** of hind wing curved up and approximate to M_3 at base (figs. 327, 320) .....19. **Desmia**
7. Male without modification at middle of antennæ; Cu_1 usually nearly straight.
8. Palpus projecting the width of the head beyond the head, with a long third segment; front rounded; wings blunt. **37. Polygrammodes.**
8. Palpus shorter, with shorter third joint.
9. Palpus with third segment shorter than wide, buried in the short vestiture of the second.
10. Ground yellow.....38. **Pachyzancla** (*bipunctalis*).
10. Ground dark brown.....25. **Pilocrocis.**

[3] *Eudioptis quadristigmalis* may run here, but is distinguished by R_5 being closely approximate to R_4 at base.

9. Third segment of palpus longer.
10. Front oblique.
11. Third segment of palpus conspicuous, well set off, squarish; with a more or less distinct tuft in front (fig. 328) ..... 33. **Samea.**
11. Third segment of palpus lying along the upper surface of the tuft on the second..... 34. **Sameodes.**
10. Front rounded (larger species).
11. Maxillary palpi small, shorter than width of tongue; second segment of labials broader..... 24. **Sylepta.**
11. Maxillary palpi moderate, fully as long as width of tongue; second segment of labials narrower (fig. 329) ..... 23. **Pantographa.**

6. Fore wing with R_5 divergent from R_{3+4}, lying about half way between R_{3+4} and M_1; somewhat approximate to R_{3+4} in Pachyzancla, which has a triangular second segment of the palpus, unlike Sylepta.
7. Second segment of palpus trapezoidal, the third lying along the upper side on the tuft.
8. Male with a fold on inner margin of hind wing; ground dark. 38. **Pachyzancla** (*perfusalis*).
8. Male without fold on inner margin of hind wing; sometimes with sex scales on costa of fore wing; ground light yellow or pale brown..... 21. **Blepharomastix.**
7. Second segment of palpus rounded; the third well set off but small.
8. Third segment a third as long as second, fine-scaled and rounded.
9. Maxillary palpi distinct; cell of hind wing at its lower angle reaching decidedly more than half way to outer margin (fig. 336) ..... 30. **Hellula.**
9. Maxillary palpi obsolete; cell of hind wing reaching hardly half way to outer margin..... 26. **Lygropia.**
8. Third segment of palpus broad and coarsely scaled, triangular. 22. **Conchylodes.**

1. Palpus more or less beaklike, porrect or oblique, with third joint porrect, and lying in the center of its terminal tuft, not on the upper side (figs. 339 to 344); upper side of second joint always convex; R_5 usually divergent from R_{3+4}.
2. Eyes much narrower than front; truncate behind, with a wide hairy and scaly area of the head behind them (fig. 337)..... 41. **Titanio.**
2. Eyes fully as wide as front, round, reaching practically to back of head.
3. Apex of hind wing angulate, subfalcate..... 40. **Diasemia.**
3. Apex of hind wing rounded.
4. Front conical (fig. 339).
5. Maxillary palpi as long as second joint of labials, broadly triangular, as in Scoparia..... 49. **Thelcteria.**
5. Maxillary palpi small and pointed..... 39. **Loxostege.**
4. Front oblique or rounded, without a point below; maxillary palpi never as long as second joint of labials, triangular.
5. Palpi twice as long as head (figs. 340, 343).
6. Hind wing yellow, contrasting with fore wing..... 42. **Tholeria.**
6. Hind wing not yellow..... 46. **Phlyctænia.**
5. Palpi projecting beyond head by less than its length (fig. 344).

6. Front rounded out half the width of the eye, or nearly so (fig. 342); male with a blister between R_4 and R_5 of fore wing. 43. **Autocosmia** (*helianthales*)
6. Front moderately rounded out or flat and oblique.
7. Hind legs twice as long as body ..... 49. **Lineodes**
7. Hind legs moderate.[36]
8. Maxillary palpi triangularly scaled, filling space between labials and front ..... 48. **Loxostegopsis**
8. Maxillary palpi slender but widened by rough scaling at tip; more or less triangular (fig. 335) ..... 31. **Evergestis**
8. Maxillary palpi small and slender.
9. Fore wing half as wide as hind wing; outer margin half as long as inner; M_3 and Cu_1 separated at margin by from a third to half an interspace (fig. 323) .... 36. **Nomophila**
9. Wings proportionate, fore wing nearly as wide (fig. 324) as hind wing.
10. Male with a bulla on fore wing and distorted venation. 32. **Crocidophora**
10. Male with fore wing pointed, much more than twice as long as wide ..... 35. **Stenophyes**
10. Male with outer tibial spurs minute, at least the upper one ..... 46. **Phlyctænia**
10. Male and sometimes female with a hyaline discal spot; brown with falcate fore wing ..... 44. **Perispasta**
10. Male without sexual modification.
11. Fore wing falcate; both wings half orange. 45. **Cindaphia**
11. Fore wing with marked or rounded apex.
12. Male antennæ broadly laminate ..... 29. **Metrea**
12. Male antennæ single ..... 47. **Pyrausta**.[37]

18. *HYMENIA* Hübner

(*Zinckenia* Zeller)

Palpi upturned (fig. 326) with the three segments nearly equal in length, the first two well set off and broadly scaled, the third much slenderer, upturned beyond vertex, smooth-scaled and acute. Male antennæ somewhat thickened and obliquely notched at base. Maxillary palpi long and fusiform. Fore wing with R_2 approximate to R_{3+4}, R_5 divergent from base; M_2 and M_3 somewhat approximate, Cu_1 well separated. Hind wing with cell, measured on the costal side, hardly a third the length of the wing, extending out below as usual; M_2 and M_3 approximate.

Key to the species.

A continuous white fascia from within cell to inner margin ..... 2. *fascialis*.
Median fascia starting below cell; the spot in cell separate, often obscure. 1. *perspectalis*.

1. **H. perspectalis** Hübner (Spotted beet worm). Brown, somewhat mottled with ochre yellow. Fore wing with a squarish spot in cell; a weak antemedial line across the wing; a postmedial fascia from costa at three-fourths way to apex, extending a third way across the wing, with two small dots below and beyond

[36] A few members of the first group with triangular palpi, may run out here, but may be distinguished from most of the following genera by R_5 which is curved and approximate to R_{3+4} at base.

[37] Sameodes may run here, but differs by its close-scaled palpi with well-set-off third joint.

s lower end; a nearly straight, but waved, fascia from below the spot in the cell) the middle of the inner margin; hind wing with a median fascia, entirely very arrow, or irregular and widened to twice its width above and below cell. All ıe markings either translucent white or obscure yellowish, defined with dark rown. 22 mm. (*animalis*, *exportalis*, Guenée, *primordialis* Zeller).

Late autumn. Larva on beet and chard; in greenhouses also on Alternanthera. reen with black tubercles. Several broods, breeding continuously in greenhouses. New York to Illinois and south; also world-wide in the warm-temperature and ropical regions. New York: Ithaca.

2. **H. fascialis** Cramer (Hawaiian beet webworm). Brown, not varied with yel-)w; antemedial line obsolete; a broad white patch running up from middle of ıner margin to middle of cell, obliquely truncate above, and often sending out a ooth toward anal angle; a large, white bar from costa, at three-fourths, halfway) anal angle; with two white dots beyond its lower edge. Hind wing with a broad, early straight, white median fascia, slightly broadened at the middle. 20 mm. *recurvalis* Fabricius). (**H. 47**:28.)

Larva on beet, chard, mangels, Amaranthus, and various weeds; sometimes njurious. The moth is taken in the North, late in the fall.

Subtropical, straying north to New York and western Pennsylvania.

19. *DESMIA* Westwood

Palpi with first two joints broadly scaled (fig. 327), the second rounded at end; hird joint short, with a more or less triangular tuft in front (less marked than n Diastichtis) well set off, attached to upper side of second joint. Fore wing of nale (fig. 320) with outer margin oblique and about as long as inner; hind wing elatively small, with lobed and sinuate costa and more or less extended anal ıngle; female more nearly normal; fore wing with marked apex; hind wing with vaved outer margin. Fore wing with R_3 and R_4 very long-stalked. Hind wing with M_3 and Cu_1 closely parallel for a greater distance than usual. Male antennæ with ı notch at middle of shaft, preceded by a scale tuft. The species are black with white markings.

1. **D. funeralis** Hübner. Black, fringe white; fore wing with two large oval spots; hind wing with a broad oval transverse band in middle, not quite reaching costa or inner margin; in the female partly or completely divided into two spots. 20–28 mm. (**H 47**:37.)

Rather common. Moth from May to October, with two or three broods. Larva (grape leaf folder) sometimes injurious to grape; more rarely on Œnothera and Cercis.

Generally distributed. New York: Fentons (Lewis County), Lewiston, Buffalo, Niagara Falls, Ithaca, Big Indian Valley, Onteora Mountain, Schenectady, Rhinebeck, New Windsor, Pearl River, Katonah.

20. *DIASTICHTIS* Hübner

(*Botis*, in part; *Bocchoris* Moore)

Front flat, oblique (fig. 334); palpi obliquely porrect, with a triangular tuft on second joint; third joint well set off, set on upper side of second, with a distinct terminal triangular tuft, rarely appressed against the tuft of second joint. Fore wing pointed, broad; R_5 moderately curved, divergent; hind wing ample; Cu_1 divergent; fringe on **Cu** more distinct than usual; cell nearly two-fifths of length of wing.

1. **D. argyralis** Hübner. Bright ochre yellow (leather-brown in the northern variety **ventralis** Grote), usually with an irregular series of dark brown ringed,

silver-white postmedial dots, the three middle ones much farther out than th others; rarely, with markings obsolete. Hind wing a little duller, usually immacu late. 25 mm.

July.

The two varieties overlap widely and intergrade. Westward the species seem also to intergrade with *D. fracturalis.*

Generally distributed, north to New Hampshire and Wyoming. New York Albany, New Windsor, Poughkeepsie, Crugers, Pearl River, Clove Valley, (State Island) East New York (Long Island).

2. **D. talis** Grote. Crimson; median area translucent yellow, divided by squarish crimson spot over the end of the cell, reaching the costa, and also touch ing the crimson base at the costa. A minute, hyaline antemedial spot. Hin wing with the crimson confined to the base; a small quadrate spot on end of cel only a third way out, touching the basal crimson area, and a broad irregula border. 18 mm.

June.

Virginia; south to the tropics.

21. *BLEPHAROMASTIX* Lederer

(*Nacoleia,* in part; *Lamprosema,* in part)

Typically with male antennæ simple and ciliate, smooth in *B. rivulalis;* fron somewhat rounded out; palpi trapezoidal, beak-like, the third segment lying alon the upper surface of the second, or somewhat prominent, obliquely divided in tw colors by a line running to the tip of the tuft; maxillary palpi slender, slightl truncate at tip when perfectly fresh, extending to the tip of the upper surface o the second joint of the labials. Fore wing fully twice as long as wide, with marke apex and anal angle, and even, slightly excurved outer margin. Venation norma (fig. 322), R_5 divergent from R_{3+4}. Hind wing with all veins divergent.

Ranalis is our only typical species. *Magualis* and *rivulalis* are transitional t Lygropia; *stenialis* is apparently a Nymphuline, near Nymphula, but R_2 is con stantly free and it is usually placed in Blepharomastix.

Key to the species

1. Evenly luteous to light brown ..... 1. *ranalis*
1. Ground yellow and white.
   2. Median area yellow ..... 2. *magualis*
   2. Median area white, except toward costa ..... 3. *rivulalis*
1. Ground yellow, heavily shaded with umber brown ..... 4. *stenialis*

1. **B. ranalis** Guenée. Clay-color, occasionally light brown, especially in western specimens; markings darker dull brown; costa shaded with brown; antemedial lin excurved, often followed by a dark dash (claviform) in fold; orbicular a well marked ring; reniform a double bar or oblong outline; postmedial line in mal normally of two parts, the upper part running straight from the costa to the outer margin at Cu_2, the inner from the discal dot to the anal angle; the two sectors sometimes connected by a line along Cu_2. Female normally with a continuous line strongly sinuate on Cu_2. A broken brown terminal line. Hind wing similar, with a single dark discal bar. 20 mm.

Larva webbing leaves of Chenopodium.

New York to Missouri and south. New York: Buffalo, Ithaca, Poughkeepsie New Windsor, New York City.

2. **B. magualis** [sic] Guenée. Yellow, base pale toward inner margin; sub

rminal space contrasting, white; lines fine, nearly black; orbicular and reniform before, heavy, and nearly filled with brown; antemedial line excurved from bicular to inner margin, an oblique basal line before it; postmedial line as in *ranalis*, but heavier, the horizontal part slightly oblique above Cu, and touching ie lower side of the reniform; subterminal line nearly parallel to postmedial, ten touching the outer margin at Cu_2, and the postmedial at its angle; twice as ar from postmedial below the horizontal part as above. A continuous brown rminal line and a broken line in fringe; a brown bar across the terminal space, pposite the cell. Palpi less beaklike at the tip than in *B. ranalis*, the entire tip own; third segment short and blunt; maxillary palpi rather shorter. This ecies and the next might go better in Lygropia. 15 mm. (*magnalis* auct.)

June.

Central Illinois and southward.

3. **B. rivulalis** Hampson. Fore wing with a fringe of rough hair on under side f costa, fore coxa and femur with expansible tufts, head as in *B. magualis*. White; ore or less of base, costa, and whole outer margin pale yellow; markings brown-lack. Hind wing similar, base with four irregular and more or less interlocking nes; the first and fourth typically complete and excurved, fifth line running to rbicular; postmedial line much as in *B. magualis*, the offset running along Cu_2 nd not touching the reniform, the space beyond it not white; subterminal line ell separated, except the horizontal portion, which is fused with the postmedial on Cu_2. Reniform a double brown bar; a brown bar beyond it in the postmedial space, elow which there is an oval white patch above Cu_2 (this region is yellow in *B. agualis*). Terminal line strong. 20 mm.

Rare; in June and in late August.

Quebec and Illinois, south to Pennsylvania and North Carolina.

4. **B. stenialis** Guenée (figs. 322, 332). Light yellow, shaded heavily with brown; he yellow ground most constant before the postmedial line, and the brown filling he terminal area, except for a narrow line just beyond the postmedial line and he costa toward the apex. Lines as in *B. ranalis*, thicker, but broken; orbicular nd reniform thick, obscured by the brown shading; basal line represented by a rown shade. Hind wing similar. Palpi obliquely upturned with segments well et off; the third segment a third as long as the second and broadly scaled; naxillary palpi truncate, subtriangular, and as long as second segment of labials. 8 mm.

Not rare; in swamps in June and July. Larva unknown, possibly aquatic. Closely related to *Geshna primordialis*, and very near the point of separation of the Nymphulinæ and Pyraustinæ.

Generally distributed. New York: Gowanda (Wild), New Windsor.

22. *CONCHYLODES* Guenée

(*Spilomela* Guenée)

Labial palpi thick and smoothly upcurved; the first two joints rather marked, not triangular, and third joint short and triangular. Maxillary palpi minute; antennæ prismatic, front flat, oblique, prominent. Fore wing with R_5 slightly approximate to R_{3+4}; hind wing with M_1 shortly stalked, M_2 and M_3 approximate.

The southern species *C. diphteralis* eats pecan.

1. **C. ovulalis** Guenée. White, abdomen with fifth to seventh segments yellow, second and fourth with black bands. Fore wing with straight basal and antemedial lines; postmedial line excurved from costa at four-fifths to inner margin at four-fifths, fine except on costa; orbicular a black patch; reniform a heavy black ellipse with a white line in the center; subterminal excurved, parallel to outer margin, much heavier than postmedial line. Terminal line rather strong, black.

A black line from inner margin at one-third up to cell beyond orbicular, then along lower side of cell to reniform, then much finer and running to inner margin at lower end of postmedial line (of which it is morphologically a part); more rarely, with its lower end joined to the lower end of the postmedial line and not going below **A**. Hind wing with black discal bar, postmedial, subterminal, and terminal lines, and loop, much as in fore wing. 25 mm. (*platinalis* auct., not Guenée). (**H 47**:60.)

June and July; September. Larva probably on sycamore. In *C. platinalis* which was described from Missouri but has since only been taken in South America the subterminal line is irregularly thickened, and the postmedial line joins the looped line above the fold.

North Carolina to central Illinois, Missouri, and south.

23. *PANTOGRAPTA* Lederer

(*Sylepta*, in part)

Similar to Conchylodes; front less prominent below (fig. 329); R_5 more strongly curved and approximate to R_{3+4}. Hind tibia of male of our species clothed with long hair on outer side.

P. limata Grote and Robinson. White, shaded with pale yellow; marked with dull brown. Basal line excurved, much nearer to base than to antemedial; antemedial line excurved and slightly wavy; orbicular higher than wide; a brown outline, constricted in the middle; claviform a brown ring, separate from antemedial line, with a line running from it to inner margin; reniform a strongly irregular brown outline; postmedial line heavy, distinct on costa, obscured below but when traceable, wavy and parallel to outer margin; subterminal wavy and parallel to outer margin, even at costa. Terminal line even, continuous. Outer third from M_1 to inner margin, and inner margin beyond middle suffused with dull brown, obscuring the marks. Hind wing somewhat suffused with brown; with a pale spot beyond the double discal bar, and a strong deeply serrate double postmedial line. 37 mm. (**H 47**:38.)

Moth in June to August. Larva a leaf roller on linden.

General in distribution. New York: Vicinity of Buffalo, Ithaca, Big Indian Valley, Ilion, Poughkeepsie, New Windsor, Long Island.

24. *SYLEPTA* Hübner

Similar to Pantograpta; male hind tibiæ normal; maxillary palpi and third segment of labials rather smaller.

1. **S. penumbralis** Grote. Light fuscous, shaded with slightly darker fuscous toward margin and slightly paler beyond the postmedial line. Palpi wholly concolorous. Lines diffuse, a little darker; antemedial strongly oblique outward, obsolete on costa; discal mark a vertical bar; postmedial line subdentate, excurved a little below cell, running far in on Cu_2, but rarely as far as opposite the discal bar. Hind wing similar; discal bar less than a third way to apex, postmedial line much as in fore wing. 30 mm. (*silicalis* Guenée.)

May; September and October.

Ohio to Illinois, Missouri, and Florida.

2. **S. obscuralis** Lederer. Identical in markings with *S. penumbralis*, but ochreous, veined and shaded with fuscous, the shading especially beyond the reniform along the outer margin; rarely nearly even fuscous. Orbicular a small dark circle, reniform a lunule, both pale filled; dark terminal bars more distinct.

Larva on *Phytolacca decandra*.

St. Louis, Missouri; Florida; an orange race in Arizona, with intergrades in Texas.

25. *PILOCROCIS* Lederer

(*Zinckenia,* in part)

Similar to Pantographta and Sylepta. Third joint of palpus rather smaller, in ome species with a triangular tuft, but smooth in the typical group (fig. 333). ntennæ of male in our species (typical Pilocrocis), with a notch at the base of ie shaft, and thickened and roughly scaled beyond. Fore wing with a thick inge on basal half of costa above.

The known larvæ eat Convolvulaceæ.

1. **P. ramentalis** Lederer. Fuscous brown; lines as in *Sylepta penumbralis,* clean- it, whitish, slightly defined on the side toward the median area, with darker own. 25–28 mm. (*perfuscalis* Hulst.)

Northward this species has only been taken in the fall.

New York to Central States and south. New York: Ithaca.

26. *LYGROPIA* Lederer

Palpi similar to those of Pantographta, upturned, somewhat broadly scaled, with arked first and second segments; third segment small, scaled, and attached to pper side of second. Fore wing with R_5 divergent from R_{3+4}. Moths slighter an in the preceding genera; normally yellowish with contrasting markings; imilar on both wings. No secondary sexual characters in our species.

A large tropical genus to which *octonalis* doubtfully belongs; *nymphulalis* and *agualis,* treated as Blepharomastix, might be better placed here.

1. **L. octonalis** Zeller. Pale lemon yellow; fore wing with a rounded light red atch at base of costa; antemedial patches on costa and inner margin, median nes on costa and cell, and sometimes a terminal bar on costal half of wing, all nely edged with black. Traces of black transverse lines. 15 mm. (*Eustixia, robena; sexmaculalis* Grote.)

Southern States; doubtful in our area.

27. *EUDIOPTIS* Hübner

(*Margaronia* Hübner; *Phakellura* Poey; *Glyphodes* Guenée; *Margarodes* Guenée, not Guilding)

Male antennæ normal in our species; palpi oblique, the second joint in *hyalinata* nd *nitidalis* (fig. 331) rounded, practically as large as the eye; third joint ninute but distinctly set off. Second joint of palpus in *quadristigmalis* (fig. 330) ather smaller, trapezoidal, with triangular terminal tuft, the third nearly con- ealed in the vestiture of its upper side and not reaching the point; the vesti- ure at the tip of the palpus wholly borne by the second joint. Palpus obliquely livided into brown and white, the line of division running almost to the tip of he tuft. Abdomen of male, in our species, with large fanlike terminal tuft. Maxillary palpi large, triangular, almost as in *Blepharomastix stenialis.* Wings fig. 321) very finely scaled, translucent; R_5 curved and approximate to R_{3+4}. Mar- ins even.

Key to the species

Fore wing white with narrow dark costa ..... 3. *quadristigmalis.*
Fore wing white with broader black costa and outer margin ..... 2. *hyalinata.*
Fore wing brown with yellow median patch ..... 1. *nitidalis.*

1. **E. nitidalis** Cramer. Fore wing brown, with a translucent irregular yellow patch extending from beyond and below end of cell to inner margin. Hind wing

translucent yellow, with marginal third brown. Anal tuft yellow and brown 30 mm. (H 47:43.)

August. Larva in stems and fruit of the melon family.

Massachusetts to Missouri and south to the tropics. New York: Albany.

2. E. hyalinata Linnæus. White. Costa with an even black-brown band reaching inner margin at base, and covering cell; outer margin with an equally broad band; hind wing with blackish band evenly tapering to anal angle, the fringe whitish. Tuft of male black and yellow (in aberration niveocilia Hampson wholly black). 28 mm. (H 47:39.)

Larva with *E. nitidalis;* sometimes injurious.

Quebec to Colorado and south. New York: Buffalo, Brooklyn.

3. E. quadristigmalis Guenée. Almost transparent; white, costa brown above R two black discal dots, and one representing orbicular, rarely absent. Tuft white 25 mm. (H p. 394 f. 217.)

Not rare.

Quebec to Colorado and south. New York: Ithaca, New Windsor.

28. *CONDYLORRHIZA* Lederer

Similar to Eudioptis; palpi beaklike, the third joint rather long and lying along the upper face of the second, reaching its tip.

Perhaps *E. quadristigmalis* would be better transferred to this genus.

1. C. vestigialis Guenée. Typically very pale brown; in variety tritealis Walker translucent light lemon yellow, with lines brown; antemedial strongly oblique out toward inner margin; orbicular a dot, reniform a short bar. Postmedial line strongly excurved at middle, sinuous, bent at a right angle below cell, and then ending perpendicular to inner margin. Terminal line and fringe brown. Hind wing concolorous, with discal bar, an irregular postmedial line, and partly fused subterminal and terminal lines, most distinctly separate toward costa. Anal tuft fanlike, black. 30 mm.

Larva on willow.

Subtropical, straying in late fall north to New York and western Pennsylvania. New York: Ithaca.

29. *METREA* Grote

Palpi upturned and not very broadly scaled, with porrect third joint, smoother than usual in Pyrausta; maxillary palpi filiform; venation normal, R_5 divergent; wings more rounded than usual.

1. M. ostreonalis Grote. White, a little translucent, especially the hind wing. Fore wing with a diffuse dark gray patch at end of cell (rarely absent) enclosing a diffuse blackish discal dot. Two large, partly confluent, obliquely placed gray patches in fold and below A, below end of cell; a gray subterminal shade below M_1, resting on inner margin. 30 mm.

July. Rare.

Quebec to Connecticut and western Pennsylvania. New York: Peru (Everett).

30. *HELLULA* Guenée

(Cabbage web-worms)

Palpi obliquely upturned (fig. 336), the first two joints marked, the third fairly long, closely scaled, oblique, well set off; maxillary palpi filiform. Venation normal, the veins well spaced; the scales on the discal bar very slightly raised, and often slightly metallic.

The species are not well understood.

1. H. undalis Fabricius. Pale luteous, usually heavily shaded with fuscous; lines white, wavy, defined with blackish; basal line fragmentary; antemedial com-

ete, transverse; postmedial complete, strongly sinuous, and distinct, sharply bent on R_1 and on Cu_2 and A; a series of black terminal dots, immediately preceded an even whitish line, defined on inner side with darker. Discal lunule black, th grayish white center kidney-shaped, concave on outer side, with more or less stinct blackish shades before and beyond it. Hind wing cream-white, with a oad, even but diffuse, darker border, and dark gray terminal line. 15 mm. *ogatalis* Hulst.)

Apparently introduced from the Old World. Larva most often on Cruciferæ d sometimes injurious in warm countries.

Southern States, probably not quite reaching our area.

2. **H. phidilealis** Walker. Similar to *H. undalis;* clay-color; hardly, if at all, aded with blackish; the lines not quite so irregular and defined with slightly rker clay-color; the region about the reniform concolorous; reniform rounded-apezoidal, oblique; rather smaller than in *H. undalis*, not concave on outer side d strongly iridescent with violet. Hind wing whiter, its border less distinct.

This form appears to be the native representative of *H. undalis*, and possibly terbreeds with it. Intermediates appear to be rare.

Southern States and southward; doubtful in our area.

31. *EVERGESTIS* Hübner

(*Pionea, Mesographe*)

Similar to Pyrausta; maxillary palpi extending fully to end of second segment labials, rather truncate at tip (fig. 335). Labial palpi rather more closely aled, the third joint porrect, moderate, pointed, its base hardly concealed in the estiture of the second joint.

1. **E. straminalis** Hübner (Purple-backed cabbage worm). Straw yellow, somehat dusted with brown; basal line obscure, angulate at middle when most istinct; antemedial line from costa at two-fifths, perpendicular to cell, deeply oncave across cell, forming a sharp tooth on Cu_1, the tooth touching the lower id of the reniform, then strongly oblique to its inner margin; postmedial line curved above; below, parallel to outer margin and slightly waved; reniform a rown outline, deeply constricted at middle, normally 8-shaped. Subterminal egion shaded with brown, outlining a triangular yellow patch on upper part of uter margin; terminal line brown. Hind wing translucent whitish, yellower oward margin, with traces of a fine brown postmedial line, and a narrow brown erminal band. 20–25 mm. (**H 49**:45.)

May to September; two broods, flying mainly in June and August. Quite variable n the amount of brown shading. Larva dark green or violet, shaded with yellow n sides and paler below; with black head and tubercles; on Cruciferæ in eptember, rarely injurious.

Very common northward; also in Europe. New York. Common everywhere.

2. **E. rimosalis** Guenée (Cross-striped cabbage worm). Fore wing rather longer han *E. straminalis;* hind wing with marked apex, less falcate than in Diasemia, ore wing light yellow, shaded with brown along the costa, over end of cell, and nore heavily on outer third; the upper boundary of the latter shade forming an blique streak running to the apex; antemedial and postmedial lines brown, weak, ubparallel to outer margin, wavy, nearly trisecting the wing; with faint lines etween them; reniform spot dark, obscure. 27 mm.

Eggs in a cluster, overlapping. Larva bluish gray with three or four transerse black stripes on each segment, and a bright yellow stigmatal band. Probbly three broods; pupa in the ground; the third brood wintering and emerging n April.

West Virginia to Illinois, Colorado, Washington, and south, New York: Long sland.

32. *CROCIDOPHORA* Lederer

Similar to Evergestis and Pyrausta; the palpi typically with the hair on the second joint longer, covering base of third (fig. 341), but short in *C. tuberculalis*. Fore wing with a bulla at end of cell, between R_4 and R_5, R_5 curved down to make room for it in males; sometimes with highly developed sexual modifications. Antennæ normal in our species.

The style of markings associates this genus with Pyrausta rather than with Evergestis; but it is customarily put here.

Key to the species

Subterminal a dentate line.....1. *serratissimalis.*
Subterminal a broad even shade.....2. *tuberculalis.*

1. **C. serratissimalis** Zeller. Male retinaculum formed into a large blackish scale tuft, covering a fovea; the base of **Cu** curved up around it; no distinct fovea in cell Cu_1, but with wing rather thinly scaled. Fore wing pale straw yellow with some light brown on veins; antemedial line somewhat waved and oblique, obscure in male, postmedial line sinuous, rather broad and even, deeply bowed in opposite cell and across Cu_2 and **A**; with more or less distinct brown shades before it; reniform a dark bar; subterminal deeply denticulate, nearly parallel to outer margin; terminal line fine, continuous, brown. Hind wing with postmedial and subterminal lines as in fore wing, but the postmedial less sinuous. 18–25 mm.

Superficially this species is very near *P. penitalis*, but is distinguished by the serrate subterminal line on the hind wing.

June to September.

New Jersey. New York: Newport, vicinity of Buffalo, Otto, Potter Swamp (Yates County), Ithaca, Schenectady, Poughkeepsie, New Windsor, New York City.

2. **C. tuberculalis** Lederer. Male with foveæ much larger, tuft representing retinaculum much larger, covering a fovea; a large fovea in cell **Cu** at base, distorting Cu_2 and lower edge of cell; which runs almost transverse from Cu_2 to Cu_1. Light straw yellow, no dark on veins; translucent. Antemedial line about as in *C. serratissimalis*, less wavy; postmedial sinuous below cell, but evenly convex opposite cell; subterminal shade much broader, even, sometimes suffused out to outer margin; terminal line obscure; discal dot faint, vertical. Hind wing with even excurved postmedial line, and broad subterminal shade. 15 mm.

June and July.

New York to central Illinois and south. New York: vicinity of Buffalo, Lancaster, Ithaca, New Windsor, Long Island.

C. pustuliferalis Lederer has narrower wings, a dentate postmedial line, and sometimes an inconspicuous dentate subterminal line. It occurs in North Carolina and southward in May. 25 mm.

33. *SAMEA* Guenée

Palpi moderate (fig. 328), upturned, the first two joints well marked off and broadly scaled, the third small, close scaled, and lying on the upper surface of the end of the second; maxillary palpi small, porrect. Fore wing subfalcate, somewhat translucent; R_5 curved and somewhat approximate to R_{3+4}. Hind wing subfalcate; a prominent tuft of scales at base of **Cu** above, representing the usual fringe.

S. ecclesialis Guenée, a widespread tropical species, may possibly occur in our area. The abdomen of the male has long curved tufts on the sides of the

ourth segment. It certainly occurs north to the coast of North Carolina. H. 48:2.)

34. *SAMEODES* Snellen

(*Pyrausta,* in part)

Palpi nearly as in Pyrausta with very little loose hair, the third joint practically erminal. Fore wing with R_5 curved and more or less approximate to R_{3+4}, apex narked. Markings as in Samea, but without the tuft on base of Cu of hind ing.

1. **S. adipaloides** Grote. Abdomen brown, in the female with some yellow scales n the base and white ones at the apex of the segments, the first segment often ellow. Male without a dorsal tuft. Straw yellow. Costa gray-brown above ; outer margin broadly gray-brown, with sharp inner boundary two-thirds way n to the postmedial line and roughly parallel to it; orbicular, claviform, and eniform spots represented by large gray-brown patches, the first two broadly n contact, antemedial line fine, gray-brown, excurved, running shortly before he orbicular and claviform; postmedial deeply sinuate below cell, extending in long Cu_2 to below end of cell; scalloped on veins; the veins more or less defined vith brown; hind wing similar, without brown patches in disc; postmedial line onfluent with border at Cu_2. 20 mm.

July to September.

Generally distributed. New York: vicinity of Buffalo, McLean Bogs, Big Indian Valley, Schenectady, Rhinebeck.

I have seen *S. elealis* Walker from North Carolina and south (*adipaloides* Barnes and McDunnough, but not of Grote's original figure and description). The costa is mostly yellow; the male has a black dorsal tuft on the abdomen, which is more largely yellow.

35. *STENOPHYES* Lederer

(*Crocidophora,* in part)

Palpi trapezoidal, closely and a little roughly scaled, with third segment terminal; maxillary palpi moderate; front oblique. Fore wing with R_5 approximate to R_{3+4}; costa practically straight; fore wing more than twice as long as wide, much more in male, with apex marked; outer margin strongly oblique and nearly as long as inner; hind wing much longer to apex than to anal angle; abdomen long and conical. Wing translucent. Markings as in Sameodes.

1. **S. huronalis** Guenée. Yellowish white; lines fine, light brown; orbicular, claviform, and reniform large, squarish orange-ochre patches, edged with brown; a yellow basal shade; antemedial line erect, wavy, nearly meeting lower angle of claviform; postmedial oblique, but less so than outer margin, offset inward on Cu_2, and then oblique to inner margin. Outer margin light brown, sending an extension to the postmedial line opposite the cell and at the anal angle. Hind wing with two broken gray transverse lines, the outer meeting margin near Cu_2; outer margin broadly gray at apex, tapering off to anal angle. Male 25 mm; female 20 mm. (*serinalis* Walker).

September and October.

Described from Canada but only seen from North Carolina and southward.

36. *NOMOPHILA* Hübner

Palpi as in Pyrausta, rather closely scaled (fig. 338); fore wing over 2½ times as long as wide (fig. 323); the outer margin less than half as long as the inner; hind wing ample, nearly twice as wide.

1. **N. noctuella** Schiffermüller. Fore wing dull gray, orbicular, reniform, and

claviform large, darker, but rarely contrasting, outlined with black; orbicular and claviform horizontally oval and often slightly separated; postmedial finely dentate when distinct; subterminal space finely strigose, with two streaks to ar interspace. Hind wing contrasting, pale luteous at base. 28 mm.

June to October.

The narrow wings and dull coloring make this species look like a Phycid. It is one of the commonest Pyralids. The larva is a general feeder on low plants and has been reported definitely from Polygonum. It is yellowish green, with darker tubercles.

Distribution world-wide. New York: common everywhere.

37. *POLYGRAMMODES* Guenée

Wings ample, the fore wing less than twice as long as wide, with strongly curved outer margin, stumpy looking. Wings translucent; R_5 strongly curved up and approximate to R_{3+4}; hind wing with a black scale tuft at base of Cu, as in Samea. Body stout, showing a strong tendency to grease; palpi as in Stenophyes.

1. **P. capitalis** Grote. White with some violet iridescence; with white fringe. Fore wing overlaid with brown wool at base and inner margin. A fine, incomplete, black, antemedial line, a rather irregular postmedial; basal line sometimes visible; orbicular a small ring; reniform a double black bar with a blackish patch below it; a blackish patch at apex. Hind wing similar. 37 mm.

June.

Mississippi Valley.

Variety **posticata** Grote and Robinson is practically immaculate, with yellowish fore wing and white hind wing. The typical *P. hirtalis* Guenée, from Texas and south, is much smaller. The names have sometimes been interchanged in collections, but I think the present use is correct.

38. *PACHYZANCLA* Meyrick

Structure much as in Nomophila and neighboring genera. Palpi rather smooth-scaled, somewhat beaklike, with third segment very small, on upper side of second. Fore wing triangular, twice as long as wide; M_2 concave up at base, and closely approximate to M_3. (I very much doubt if this genus is either natural or in the right place here.)

1. **P. perfusalis** Walker. Fore tibia with a terminal tuft. Inner margin of hind wing distorted; anal angle lobed in male, with a short, stiff tuft, and an area of black raised scales above Cu_2, which is distant from Cu_1 at margin. Dark fuscous, antemedial line darker, excurved; postmedial running in a broad sweep from costa, far out toward outer margin, then in below cell to opposite reniform, then nearly erect to inner margin. A blackish discal bar. Hind wing duller, with a slight postmedial line only. 22 mm.

Larva on eggplant.

Southern States; not seen from our area.

2. **P. bipunctalis** Fabricius. No secondary sexual characters. Ground color dull luteous, darkening on costa and outer margin, and on apical half of outer margin of hind wing; with a short thick solid black reniform spot hardly higher than wide, and smaller round orbicular dot. Subterminal line absent, and postmedial indented opposite the cell. 25 mm.

Larva (southern beet webworm) on beet and a great variety of other herbaceous plants; injurious in the Gulf Strip.

Decatur, Illinois, and south. The eastern records, so far as traced, are in error for species of Phlyctænia and Pyrausta, especially *Pyrausta nertextalis*.

I believe this species would go better in Sylepta.

39. *LOXOSTEGE* Hübner

(*Phlyctænodes* Guenée, *Eurycreon* Lederer)

Similar to Pyrausta, but with the lower part of the front drawn out into sharp cone, or, in some western species, a more complex process (fig. 339). ind wings usually more simply marked than fore wings. Eyes normal in our ecies, reduced in some western ones.

Key to the species

1. Expanse 10 mm ..... 10. *ophionalis.*
1. Expanse 15 mm. or more.
2. Fore wing falcate ..... 1. *externalis.*
2. Fore wing with apex at most marked.
3. Fore wing mostly white, with yellow costa ..... 7. *dasconalis.*
3. Fore wing yellow, nearly or quite immaculate.
4. Hind wing concolorous ..... 8. *marculenta.*
4. Hind wing white ..... 3. *similalis*, variety *posticata.*
3. Fore wing contrastingly marked, or fuscous.
4. Fuscous with a contrasting light yellow terminal band and square between orbicular and reniform.
5. Postmedial line denticulate and fine in its upper course. 4. *stictícalis.*
5. Postmedial with its outer side even, often represented by a series of black wedges ..... 5. *commixtalis.*
4. Less mottled, terminal space and space between orbicular and reniform not contrastingly pale.
5. Cream-white, with contrasting gray or olivaceous veining, and dentate postmedial and subterminal lines, checkering the outer part of the wing ..... 6. *chortalis.*
5. Veins concolorous; postmedial line evenly sinuous; ground not cream-white with contrasting dark markings.
6. Lemon yellow, with broad contrasting rusty marks, including a terminal line on hind wing but no subterminal ..... 2. *helvalis.*
6. Straw yellow, with light brown to obsolescent markings, and separate subterminal and terminal lines on hind wing, or with the subterminal line only.
7. Postmedial line strongly denticulate; hind wing with postmedial line distinctly curved above Cu_2 ..... 8. *marculenta.*
7. Postmedial very slightly denticulate or even, on hind wing straight to below Cu_2 ..... 9. *mancalis.*
6. Fuscous to ochreous, hind wing with, at most, slight diffuse markings, usually immaculate in pale forms ..... 3. *similalis.*

I. *Fore wing falcate; hind wing with* M_2 *and* M_3 *closely approximate. Frontal prominence broad at the end, somewhat chisel-shaped.*

1. **L. externalis** Warren. Front with white side-lines. Light dull brown; lines fine, single, dark; antemedial irregular, excurved; postmedial sinuous, denticulate, not bent in opposite cell; orbicular a dot and reniform a curved vertical line, all faintly defined with paler; no subterminal line. Hind wing slightly paler, with obsolescent postmedial only. 22–25 mm. (*maclurœ* Riley).

Larva on Osage orange.

Plummer's Island, Maryland; western Pennsylvania, Illinois, and St. Louis, Missouri, south to North Carolina and Texas.

II. *Fore wing not falcate, front definitely conical, usually with a sharp point; hind wing* M_2 *and* M_3 *closely approximate.*

* *Hind tibiæ with outer spurs about half the length of the inner.*

2. **L. helvalis** Walker. Bright yellow; lines clean-cut, yellow-brown, single and not denticulate; costa yellow-brown; antemedial excurved; postmedial broadly excurved above, with a blunt inward tooth on fold; orbicular a dot, reniform a curved line; no subterminal. Hind wing paler, with a short straight postmedial line pointing toward anal angle; both wings with even terminal lines. 15–20 mm. (*citrina* Grote and Robinson.)

September.

Coast of Massachusetts to Florida and Texas. New York: Long Island.

3. **L. similalis** Guenée. Typically dull ochre, somewhat shaded with fuscous; lines diffuse, dark, shading imperceptibly into the median area, usually more sharply defined on the side away from the median area, and defined with pale. Terminal line waved, postmedial somewhat sinuous and denticulate, when distinct. Orbicular a blurred spot; reniform an oval spot or lunule, both dark and diffuse. Hind wing somewhat paler, dark toward margin, translucent at base; in fully marked specimens, with broad, vague, dark border, and sometimes a faint dark postmedial line. 20 mm. (*licealis* Walker, *communis* Grote, *caffrei* Flint and Malloch.

Variety **intractella** Walker is the dark, fuscous form; *rantalis* Guenée is probably the same form; **crinitalis** Walker is brighter rusty orange, and **posticata** Grote and Robinson (*miserulata* Grote and Robinson) is nearly immaculate yellow with an immaculate white hind wing. Intergrades are common.

Larva (the garden webworm) a general feeder, rarely injurious. Dull green above and yellowish below, with a double pale dorsal, and whitish lateral, line. Tubercles black. Four or more broods.

Generally distributed. New York: Saranac Inn, Ithaca, Albany, Nassau; Woodhaven, Long Island.

4. **L. sticticalis** Linnæus. (Sugar-beet webworm.) Superficially very close to *L. commixtalis;* upper outer spur of male hind tibiæ nearly half as long as lower one. A little smaller than *L. commixtalis* and more lightly built. Fore wing with basal dash and streaks on veins nearly obsolete, light fuscous; orbicular thicker and more obscure; postmedial line distinctly and finely denticulate; yellow terminal shade widened opposite the cell, followed by a single dark terminal line. Hind wing nearly concolorous, with a vague pale postmedial shade; yellow marginal shade evener; terminal line single. 25 mm.

Larva gray-green, yellower on sides, with black head and pale, dark-ringed tubercles; a general feeder and sometimes injurious in gardens.

Nantucket, Massachusetts; Madison, Wisconsin; Western States; Europe; probably introduced in the East. New York: Ithaca, Big Indian Valley, East New York.

** *Upper outer spur of male hind tibia reduced, less than a quarter the length of the inner spur.*

5. **L. commixtalis** Walker. Middle tibiæ with a groove and pencil. Luteous, heavily streaked with fuscous, especially on veins; terminal space yellow, not broadened opposite cell; a long black basal dash with a pale shade above it; antemedial line far out, deeply dentate, the longest tooth in the fold; orbicular a horizontal ellipse when distinct, often confused with antemedial line; followed by a yellow patch; this patch sometimes divided by a black dash connecting the orbicular and reniform spots; postmedial line represented by a series of black wedges, conspicuous beyond the cell, where their outer sides form an even line, and their points extend in along the veins to the

reniform, which is confused; black postmedial line deeply dentate below and finely so toward costa. A fuscous subterminal shade; terminal line double, the outer line in the fringe. Hind wing paler fuscous, sometimes with blackish veins on disc, sometimes with a vague yellowish postmedial shade, and narrower irregular yellow terminal band; blackish terminal line double. (A specimen from Newfoundland has all the yellow shades on the fore wing, except the terminal band, replaced by light blue-gray.) 25–28 mm. (*cereralis* Zeller.)

Usually rare; sporadically injurious; usually confused with *L. sticticalis*, but easily distinguished in the male, by the hind tibiæ. Larva about like that of *L. sticticalis*.

General in distribution. "New York" (Grote).

6. **L. chortalis** Grote. Pale yellowish, marked and shaded with light gray, appearing greenish on account of the yellow underlay. Veins contrasting gray; postmedial line serrate; subterminal gray, normally serrate; basal markings confused, largely lost in gray shading; hind wing whitish, with wavy subterminal and variable, often obscure, postmedial lines; terminal line dark gray. 25 mm.

Not rare from May to August.

General, north to Northern Ontario and west to California. New York: Black Brook, Uphill Brook (Mt. Marcy), Clayton, Buffalo, Ithaca, Big Indian Valley, Onteora Mountain, Karner, Albany, Rhinebeck, New Windsor.

7. **L. dasconalis** Walker. White, with traces of the markings of *L. chortalis* and a faint light gray terminal line; front of thorax and base of costa bright yellow.

Apparently rare. June to August. Larva on Baptisia.

Massachusetts to Illinois and south. New York: New Windsor.

8. **L. marculenta** Grote. Upper outer spur minute. Pale lemon yellow; head deeper ochre; markings pale brownish gray, very slightly diffuse; antemedial line excurved and somewhat wavy; postmedial sinuous and moderately dentate, most deeply on Cu_2; subterminal a vague shade; terminal fine; orbicular and reniform small and diffuse. Hind wing similar toward margin, nearly hyaline white toward base; postmedial straight or curved; subterminal close to margin, sometimes fused with terminal line or absent in pale specimens. Markings often nearly obsolete. 20 mm. (probably *obliteralis* Walker.)

May to August. Larva on Solidago.

Massachusetts to Texas. New York: General.

9. **L. mancalis** Lederer. Upper outer spur one-quarter the length of the inner. Similar to *L. marculenta* and usually confused with it. Rather duller straw yellow; rarely, with brown veins as in *L. chortalis*; postmedial line almost evenly sinuate on fore wing; on hind wing straight from below costa to fold, and stopping there. Subterminal distinct, close to margin. Front brown with whitish shades; palpi light brown.

June; August. Caterpillar on Convolvulus, Rumex, and mint.

Maryland to Missouri and south ("Maine" in error).

III. *Very small species; costa and outer margin nearly straight, meeting at a sharp angle; front as in* L. externalis; *palpi twice as long as head; maxillary palpi large, triangular, truncate at tip, hind wing with* M_2 *and* M_3 *widely separate, parallel at base.*

10. **L. ophionalis** Walker. Light yellow, suffused with tawny and brown; with a single straight red-brown and yellow subterminal band. 10 mm.

North Carolina and south.

A closely related form, with crimson ground-color, occurs on the sand barrens of Illinois. It may be a race of *ophionalis*.

40. *DIASEMIA* Guenée

Palpi about as in Loxostege; rather short. Maxillary palpi large, triangular; male antennæ broad and typically subserrate in male. Fore wing typically with falcate apex; venation normal, with R_5 divergent. Hind wing with apex subfalcate, outer margin excavate below it; M_3 and Cu_1 approximate; cell two-fifths length of wing; front rounded.

Only the type species is normal in structure, *janassialis* is probably not really congeneric.

1. **D. ramburialis** Duponchel. White, striate with yellow and dusted and mottled with brown-black; the white showing especially as a very irregular postmedial line, widened on costa and forming a contrasting patch on inner margin. Fringe cut with white. Hind wing with white mostly in broad antemedial and medial bands, with a solid black band between them. 15 mm.

Europe; Atlantic States; seen only from Florida.

2. **D. janassialis** Walker. Male antennæ strongly annulate, with rows of raised scales; hind wing excavate opposite cell, but not falcate; venation as in Pyrausta; palpi long, beaklike. Black, with heavy white postmedial line, discal spot, partial antemedial line and other usual markings; not at all powdery or striate.

Southern States, north to North Carolina; not known in our territory.

3. **D. magdalena** Fernald occurs north to North Carolina. It is yellow, with fine silvery ante- and postmedial lines converging to the inner margin, and with a similar terminal line and confused discal marks.

41. *TITANIO* Hübner

(*Botis*, in part)

Similar to Pyrausta; front more prominent, rounded out and rough-hairy (fig. 337); gena a third as wide as eye, pale and conspicuous in *pollinalis;* eye narrower than front, with a chitinized band behind it; vestiture rough and more hairy than usual; with tufts on the tips of the large maxillary palpi.

This is a subarctic development of Pyrausta, and apparently intergrades with it. Two or three species placed here in Titanio have been generally considered Pyraustas, but have the characteristic small diurnal eyes of this genus.

Key to the species

1. Black with two white spots on fore wing ..... 1. *pollinalis.*
1. Gray.
   2. Postmedial line straight, whitish ..... 4. *marginalis.*
   2. Postmedial line dark, denticulate and sinuate ..... 2. *ephippialis.*
   2. Markings obsolete ..... 3. *torvalis.*
1. Ground of hind wing yellow ..... (*insequalis* group of Pyrausta).

1. **T. pollinalis** Schiffermüller. Black; two white spots on fore wing and a broken median fascia on hind wing. 20 mm.

May and June; August. Larva on broom and other Leguminosæ.

Europe; reported from Pennsylvania.

2. **T. ephippialis** Zetterstedt. Gena black, naked. Dark ash gray, somewhat powdery, especially the darker base; antemedial line wavy, oblique outward, dark; postmedial well out; excurved above, extending far in below cell, enlarging into

dots between veins; median area sometimes paler; ordinary spots small, solid, dark. Hind wing dark gray with more or less distinct dark and pale postmedial line and pale costa. 20 mm.

July.

Holarctic, south to Labrador.

3. **T. torvalis** Mœschler. Dark fuscous, with some white scales, markings almost obsolete, so far visible like *T. ephippialis*. Hind wing much paler. 20 mm.

Greenland to Labrador.

4. **T. marginalis** Walker. Powdery mouse gray; blackish toward base and beyond postmedial line; under the lens showing blackish, white, and orange-brown scales. Antemedial line obscure, outwardly oblique, waved, postmedial line nearly straight, white, contrastingly defined with blackish; orbicular a black spot, and reniform a small black patch; median area slightly paler, grayer, and more powdery. Hind wing with black-brown powdering on a luteous base; with a short straight postmedial line. 18 mm. (*stenopteralis* Grote.)

May.

Maine to Alberta.

42. *THOLERIA* Hübner

(*Mecyna* Guenée)

Structure as in Phlyctænia, the third segment of the palpus not well set off, somewhat down-curved (fig. 340); midtibia with a groove and tuft of hair in male. Hind tibia normal; M_2 and M_3 more closely approximate than normal in Phlyctænia and Pyrausta.

1. **T. reversalis** Guenée. Fore wing brown with faint markings; hind wing bright yellow, with blackish apex. 30 mm.

June and July. Larva on Baptisia and Lonicera.

New York and Illinois to Florida and Colorado. New York: Ithaca, Oneonta, New Windsor, Staten Island; Glencove, Long Island (in a conservatory).

43. *AUTOCOSMIA* Warren

(*Titanio; Metasia,* in part)

Front typically conically prominent, in our species (fig. 342), which belongs doubtfully to the genus, oblique and rounded out. Our species with a bulla between R_4 and R_5 of the male, as in Crocidophora; palpi moderate, beaklike, the third segment not well set off; hairy, normal; eyes wider than front; maxillary palpi larger, triangular; no veins approximate, not even M_2 and M_3; wings rounded, with costa more arched than usual; normal.

1. **A. helianthales** Murtfeldt. Ash gray, shaded with whitish, especially over the end of the cell, and costa opposite; postmedial line fine, white, convex above, more oblique than outer margin below, even, nearly touching terminal line opposite cell; a more or less irregular streak on **A** out to postmedial line, forked near its tip; a white line in base of fringe, preceded by a dark terminal line. Hind wing pale gray, with a white postmedial line far out, but receding toward anal angle. Upper tibial spurs more than three-fourths way to apex of tibia, very small. 12 mm.

April to July. Larva forming a large blotch mine in leaves of sunflower, the scattered frass mostly on one side. Whitish green, sometimes shaded with rosy. Head mottled brown, with whitish front; cervical shield whitish green with two large brown spots covering most of its surface. Tubercles dark. Pupa usually in the mine. Three broods, the last hibernating as larvæ in the cocoon.

Northern and central Illinois; St. Louis, Missouri; Texas.

44. *PERISPASTA* Zeller

(*Pionea*, in part)

Similar to Pyrausta; fore wing in male with R_5 divergent from R_{3+4}, running through the middle of a large hyaline patch beyond the cell, M_1 in male below the hyaline patch, near lower angle of cell; in female from middle of end of cell; fore wing falcate.

1. **P. cæculalis** Zeller. Dark fuscous, with a faint excurved and sinuous darker postmedial line; fringe white in notch; hind wing nearly concolorous, with faint postmedial line and fringe white toward apex.

Not common. June to August.

Quebec and New Jersey to Manitoba, Colorado, and Texas. "New York" (Grote).

I have taken this species within two miles of the New York boundary, at Ramsey, New Jersey.

45. *CINDAPHIA* Lederer

(*Phlyctænia*, in part)

Similar to Pyrausta; fore wing subfalcate; abdomen rather long. Hind tibiæ of male much swollen, with both outer spurs reduced; mid-tibiæ slender.

1. **C. bicoloralis** Guenée. Orange; outer two-fifths brown, the boundary marked by the sinuous darker brown postmedial line. Hind wing similar. 18 mm. (**H 47**:40.)

May and June; late July to September.

Generally distributed. New York: Lancaster, Ithaca, Big Indian Valley, Albany, Rhinebeck, Poughkeepsie, New Windsor, New York City.

46. *PHLYCTÆNIA* Hübner

(*Pionea* Guenée; *Udea* Guenée)

Similar to Pyrausta; palpi usually longer (fig. 343); middle tibiæ usually swollen; hind tibiæ usually with upper outer spurs rudimentary.

The genus is hardly distinct from Pyrausta. For key to species see Pyrausta.

* *Upper outer spur of hind tibia much reduced.*

1. **P. ferrugalis** Hübner (Celery leaf tier). Palpi twice as long as head. Hind tibia with upper outer spur obsolete. Dull light brown, sometimes reddish, or dusted with black; orbicular a slightly darker circle, reniform an hourglass-shaped spot; postmedial line parallel to outer margin from R_5 to Cu_2, somewhat offset in on R_5, and deeply looped in on Cu_2 and fold; with fine dark terminal dots and a double gray line in fringe. Hind wing much paler; fuscous toward outer margin, with a fuscous bar on upper half of discocellular; a spot on crossvein m-cu, distincter below, and a fine dark gray postmedial line. 18 mm. (*rubigalis* Guenée).

Common all the year. Larva transparent green, with a white subdorsal stripe, and a pair of black spots on cervical shield. Head and tubercles pale. A general feeder on herbs, often injurious in greenhouses. Several broods.

Massachusetts to Missouri and south. New York: Rochester, Brockport, Buffalo, Crosby (Yates County), Ithaca, Big Indian Valley, Albany, Pearl River, New Windsor.

2. **P. acutella** Walker. Straw color, somewhat shaded with pinkish, broadly

streaked on the veins and more or less suffused with pale brown; no transverse markings, not even terminal dots. Hind wing yellowish, unmarked. 25 mm. (*venalis* Grote).

June to August.

Quebec to Wisconsin, south to southern New Jersey and Colorado. New York: vicinity of Buffalo, Potter Swamp (Yates County), Ithaca, Karner, Nassau, New Windsor.

3. **P. terrealis** Treitschke. Palpi as long as head. Pale fuscous, heavily powdered on a luteous ground; markings darker, faintly defined with pale, diffuse, obscure. Antemedial line excurved, postmedial sinuous, running in to below the cell at **Cu** and then obliquely into inner margin at two-thirds way to hind angle; orbicular a vague dot, reniform a dark bar. Hind wing paler and translucent, except at margin, with diffuse darker postmedial line. A distinct gray terminal line and two dark lines in fringe on both wings. 25 mm.

Two broods, flying mainly in May and August. Larva green, with black-dotted head and small black tubercles; on Solidago.

Quebec, south to northern New Jersey, west to British Columbia and California; Europe. New York: Peru, North Creek, Lancaster, Jamestown, Crosby (Yates County), Ithaca, Big Indian Valley, Onteora Mountain, Fort Edward, Schenectady, Rhinebeck, New Windsor.

4. **P. extricalis** Guenée. Cream color, dusted with dull brick-red, more coarsely than in *P. terrealis*. Antemedial line dentate, postmedial deeply and sharply dentate, drawn in below cell on Cu_2, as usual. Subterminal absent. Orbicular an obscure point, and reniform a vague lunule. Hind wing similar, postmedial line far out across M_2 to Cu_1, as usual in the obscure Pyraustas; nearer outer margin than end of cell, then sharply angled in at Cu_2; usually strongly dentate; often distinct only opposite the end of the cell. 25 mm. (*dionalis* Walker, *oppilalis* Grote).

May and June; July; September. Larva a leaf roller on alder.

Generally distributed. New York: Peru, Newcomb, Big Indian Valley, Schenectady.

The coarser, less regular dusting, obvious to the naked eye, will distinguish this species from *P. terrealis* and *theseusalis*.

4½. **P. helvalis** Walker. Similar to *P. extricalis;* normally more powdery, rougher looking, with orbicular a ring and reniform at least a double bar; hind wing paler, with more dentate postmedial line.

This species is only certainly distinguishable from *extricalis* on genitalic characters, and I am not at all sure I have credited the various New York records to the right species. Both tend to be redder in the southern part of their range and grayer in the north. The caterpillar of *helvalis* is a leaf roller on poplar, emerging in July.

Nova Scotia to Missouri. New York: Black Brook, Ithaca, Neversink.

5. **P. theseusalis** Walker. Palpi exceptionally short. Wings dull ochreous, shaded with dull light brown, or, more often, almost wholly light brown, except narrowly beyond the postmedial line. Lines contrasting, hardly diffuse, dark brown, antemedial excurved, practically even; postmedial waved and sinuous; orbicular a dot, and reniform a brown bar. Terminal line continuous. Hind wing similar. Discal dot of hind wing below obscure. 25 mm. (*feudalis* Grote).

July. Larva rolling the tips of various ferns, in June.

General in distribution; Canada to Florida. New York: Mt. Marcy, Lewis County, Lewiston, Ithaca, Karner, Rhinebeck, Katonah, New Windsor.

6. **P. tertialis** Guenée. Pale straw yellow or luteous, marked with dull brown; lines single, contrasting, brown; antemedial excurved, postmedial sinuous and strongly bent in below end of cell, strongly dentate; subterminal in light specimens deeply dentate, the teeth touching the postmedial and terminal lines alter-

nately, enclosing yellowish lunules beyond the postmedial and a fine dentate yellowish line before the terminal dots, which are triangular and alternate with the teeth of the subterminal line; a continuous brown line in base of fringe; hind wing similar. Orbicular and reniform usually suffused brown patches. 15–20 mm. (*plectilis* Grote and Robinson; *syringicola* Packard). (**H 47**:47.)

In dark specimens the wing suffused with brown, the yellow only showing in small spots and streaks, except a postmedial patch on the costa, one between the orbicular and reniform, and a larger one between the reniform and postmedial line beyond cell.

May to July; August. Larva in pith of elder.

Generally distributed; very common northward. New York: common everywhere.

** *Outer upper spur of hind tibia of male almost half as long as inner, about as in female; palpi beaklike, exceeding the head by twice its length.*

† *Fore wing exceptionally broad and squarish.*

7. **P. fumalis** Guenée. Fawn to chocolate brown; lines dark, not strongly dentate, single and contrasting; antemedial convex; postmedial somewhat excurved above, well out, nearly parallel to outer margin; angled on Cu_1, and sharply concave to inner margin, but only running halfway into cell; reniform a lunule or obscured by a blackish patch. Hind wing grayer, with a slightly wavy postmedial line parallel to outer margin, the disc often suffuse with dark gray. 22 mm. (**H 47**:55.)

June to September.

Nova Scotia to Pennsylvania and west. New York: Wilmington, Saranac Lake, Old Forge, Newcomb, North Creek, Fentons (Lewis County), Honeoye Falls, Oak Orchard Swamp, Ithaca, Big Indian Valley, Karner, New Windsor.

†† *Fore wing narrow, with short outer margin and arched costa.*

8. **P. itysalis** Walker. Luteous, the costa shaded with blackish, and orbicular and reniform large and blackish; hind wing with obscure markings, whitish, with a black dot on **m-cu**, as in *P. ferrugalis*. 28 mm. (*P. turmalis* Grote, *hyperborealis* Möschler, *tillialis* Dyar.)

July.

This species is transitional to Nomophila, but is easily distinguished from *N. noctuella* by its light ground color and its less exaggerated wing form.

Labrador; Mt. Washington, New Hampshire (5000 feet). Widespread in the Western States.

††† *Fore wing narrow, triangular, with straighter costa.*

9. **P. roseopennalis** Hulst. Fore wing with oblique outer margin and subfalcate apex; hind wing rounded; antennæ annulate with rows of raised scales; front oblique, palpi fully twice as long as head; hind wing with M_2 and M_3 well separated, as in the last group of Loxostege. Fore wing pale yellow, with pink costa, except sometimes in the subterminal region; with the orbicular and reniform partly confluent with it; pink outer margin, and a large patch on outer part of inner margin, sometimes touching the reniform. Hind wing white, slightly yellowish at the apex. 18 mm.

May, June, and September.

Virginia; North Carolina; New Brighton, Pennsylvania; Arizona.

P. radiosalis Möschler, from Labrador, is unknown to me.

47. *PYRAUSTA* Schranck

(*Botis*, etc., in part)

Palpi beak-like, exceeding head by rather more than its length, usually more or less hairy (fig. 344); the third joint not well set off; eyes normal or nearly so; maxillary palpi porrect; front oblique but not conical or chisel-shaped. Hind tibiæ of male with spurs normal. Wings ample (fig. 324). Fore wing with all veins normal, divergent; M_2 not at all concave at origin, hardly approximate to M_3; frenulum-hook often absent; hind wing with M_2 and M_3 only shortly approximate. No decided secondary sexual characters. Markings various.

In the first group of the genus the markings are, except as noted, single, dark, on a somewhat lighter ground, with a more or less distinct paler shade beyond the postmedial line; antemedial line excurved, more or less waved, from costa at a quarter way out to inner margin before a third way out; the postmedial waved or dentate, well out, and concave opposite cell; excurved from M_1 to Cu_1, then running in deeply to below end of cell above Cu_2; nearly perpendicular to inner margin; the subterminal line distinct, diffuse, or absent. The orbicular and reniform are normal in position, the former circular and the latter kidney shaped. The hind wing is similar or somewhat paler, with the antemedial line absent; a curved discal bar confined to the discocellular vein; no dark spot on m-cu; postmedial line running much as in fore wing, nearer outer margin than end of cell across M_2 to Cu_1, concave above and retracted below Cu_2; subterminal as in fore wing. The under side is much like the upper side, but with the markings more diffuse and the fore wing shaded with fuscous. The species are very close and some are doubtful. Of the Phlyctænias, *P. terrealis*, *extricalis*, *theseusalis*, and *helvalis* have similar patterns except as noted, also the *Crocidophoras*, *Pilocrocis ramentalis*, *Pachyzancla perfusalis* and *bipunctalis*, the *Syleptas*, etc.

Key to species of Pyrausta and similar forms

1. Both wings with basal half yellow and outer half brown. (*Cindaphia bicoloralis*).
1. Basal half of wings not contrastingly paler than outer half.
2. Ground black; rarely, somewhat grayish on fore wing.
3. White fringe only, or a faint postmedial shade also.....30. *niveicilialis*.
3. Grayish black, with darker postmedial line.....(*Perispasta cœculalis*).
3. Two white spots on each wing.....29. *funebris*.
3. A white sinuous postmedial line and other markings. (*Diasemia janassialis*).
2. Immaculate dark lead gray; base dusted with white.....32. *demantrialis*.
2. Ground not black (rarely, purple-black marked with yellow).
3. Fore wing with longitudinal streaks only.....(*Phlyctænia acutella*).
3. Fore wing with transverse markings, with spots, or immaculate.
4. Hind wing nearly immaculate yellow, contrasting with the brown fore wing .....(*Tholeria reversalis*).
4. Hind wing not yellow and contrasting with the dark fore wing.
5. Hind wing orange-red, without pattern.....23. *tyralis*.
5. Hind wing bright orange to bright yellow; if yellow, marked with black or blackish.
6. Hind wing with dark border and fine postmedial line only; fringe of fore wing dark.
7. Fore wing with a yellow patch beyond cell, before the postmedial line, which is often obscure above, but always distinct and strongly excurved on under side.....20. *ochosalis*.

7. Fore wing with yellow postmedial markings beyond the postmedial line, which is always distinct.
8. Hind wing with two yellow bands parallel to outer margin. 28. *subsequalis, borealis.*
8. Hind wing with one broad yellow band, and black border, parallel to outer margin.....21. *generosa.*
8. Hind wing with postmedial yellow band straight as far as Cu_2, and pointing to anal angle.
9. Ground black-brown.....*rubricalis* (western).
9. Ground light red-brown.....17. *phœnicialis.*

5. Hind wing pale yellow, without broad and clean-cut contrasting markings, or not yellowish (sometimes with a pattern of fine lines or dots).
6. Fore wing marked with pink, crimson, or purple (reduced to slight shades in some *acrionalis*).
7. Fore wing dominantly light yellow, with pink borders and a large patch at anal angle.....(*Phlyctænia roseopennalis*).
7. Fore wing half pink and half yellow, the pink not forming an anal patch or postmedial fascia.....22. *laticlavia.*
7. Fore wing olive, more or less shaded with purple. 22. *laticlavia*, variety *cinerosa.*
7. Fore wing varying from pink to violet; sometimes suffused with gray; often with a pale yellow terminal band and fringe.
8. Hind wing with a diffuse gray shade at border, or all gray; yellow postmedial spot beyond the postmedial line. 19. *acrionalis.*
8. Hind wing with a definite dark border, suffused with purple; yellow postmedial spot beyond the postmedial line.
9. Under side of cell with a square yellow patch surrounded on three sides with gray; a similar larger patch beyond cell. 17. *phœnicialis.*
9. Larger; markings diffuse below; the patch in the cell hardly indicated .....18. *onythesalis.*
7. Fore wing with small white markings only.
8. Postmedial line reduced to a costal bar; antemedial absent. (24). *angustalis.*
8. Antemedial line distinct; postmedial practically reduced to a bar on costa.....25. *inveterascalis.*
8. Antemedial line more or less distinct; postmedial complete. 24. *signatalis.*

6. Fore wing without pink, crimson, or purple markings.
7. A contrasting, sinuate, yellow postmedial line, sometimes interrupted on the middle third.....26. *nicalis.*
7. A large pale yellow postmedial patch only.....27. *unimacula.*
7. Markings more complex, with distinct dark postmedial line, or ground pale.
8. A contrasting pale yellow spot beyond postmedial on costa, and a larger one at lower angle of cell, with the postmedial line between them.....(*Phlyctænia tertialis*).
8. No contrasting pale spots on fore wing, or with both spots beyond the postmedial line.
9. Outer margin broadly and evenly fuscous beyond subterminal line.
10. Subterminal line deeply dentate, forming strong teeth; or (*nubilalis*) overlaid with the marginal shade.

11. Ground straw yellow, shaded with reddish and chocolate brown .....10. *nubilalis* (male).
11. Ground cream-white.....2. *thestialis*.
10. Subterminal line slightly irregular, sinuous, clean-cut (Sameodes species).

9. A broad subterminal band, contrasting with the yellowish outer margin; ground yellowish.
10. Subterminal band much broader than margin, clean-cut and irregular .....5. *langdonalis*.
10. Subterminal band straight and quite diffuse, always strong on costal half of hind wing; sometimes lost on fore wing when all the markings are obscure. 16. *fodinalis*.

9. No subterminal band; ground broadly dark beyond the postmedial band, which is near the margin....31. *inquinatalis*.
9. Not yellow; or white with a broad dark terminal or subterminal band.
10. Fore wing with white ground, more or less heavily dotted with black; often with large brown or black orbicular and reniform spots.
11. Palpi twice as long as head....(*Phlyctænia itysalis*).
11. Palpi projecting beyond head by a little more than its length .....11. *illibalis*.
10. Fore wing not white and dotted or suffused with black.
11. Palpi twice as long as head, reniform constricted at middle, hourglass-shaped...(*Phlyctænia ferrugalis*).
11. Palpi shorter; reniform not hourglass-shaped.
12. Hind wing with postmedial line even and nearly straight, from near costa to **Cu** close to lower angle of cell, tending to become obsolete; ground pale yellow.
13. Postmedial evenly sinuate, almost always with dark brown spots before it opposite cell and over the roots of M_2 to Cu_1.....(*Crocidophora* species).
13. Postmedial regularly dentate; at most with a diffuse brown shade before it.
14. Ground bright yellow; in male, overlaid with brown; with clear white stripes on sides of front .....10. *nubilalis*.
14. Ground paler straw yellow; male dusted with rusty or shaded with light brown; stripes on sides of face paler straw yellow, obscure. 8. *penitalis*, 9. *ainslei*.
12. Fore and hind wings with similar complex markings; the hind wing often paler, with the markings somewhat simplified, but postmedial line at least distinct, and offset out, or running far out, as near margin as to cell, opposite lower angle of cell.
13. Straw to lemon yellow, marked with brown.
14. Subterminal line much heavier than postmedial, more or less diffuse, and suffused with the red-brown terminal shading.....(6). *oxydalis*.
14. Subterminal line not heavier than postmedial; margin yellow .....6. *flavidalis*.
13. Not bright yellow.

14. Reniform a solid bar, sometimes nearly obsolete; subterminal line obscure or absent.
15. Subterminal a distinct dark shade; median area more or less suffused with fuscous, leaving the space between orbicular and reniform contrastingly pale.....4. *æglealis.*
16. Postmedial line strongly and evenly dentate .....(*Phlyctænia extricatis*).
16. Postmedial line obscurely or not at all dentate.
17. Wings very broad; postmedial line in fore wing crossing Cu_2 nearly at right angles, well beyond cell..(*Phlyctænia fumalis*).
17. Wings normal; postmedial line retracted in on Cu_2 to below end of cell.
18. Ground dull brown or ochreous to light fuscous.
19. Discal dots and lines blackish, contrasting..(*Phlyctænia theseusalis*).
19. Discal dots and outer line obscure. (*Phlyctænia terrealis*).
18. Ground cream color.....7. *submedialis.*
14. Reniform more or less distinctly double, with pale center; always thick and squarish; subterminal line distinct, dentate.
15. Markings very delicate and broken into series of dots.....3. *fissalis.*
15. Postmedial line continuous, subdentate; subterminal continuous, dentate, delicate; ground yellow.
16. Expanse under 25 mm.; less iridescent. 1. *pertextalis.*
16. Expanse over 25 mm.; markings coarser; ground whiter, with bluish iridescence. 2. *thestialis.*
14. Reniform double; subterminal line completely absent .....*Phlyctænia helvalis.*
12. Hind wing hardly, or not at all, marked.
13. Immaculate ochreous, or with normal markings somewhat ill-defined and light red-brown.
14. Hind wing concolorous.....13. *inconcinnalis.*
14. Hind wing nearly white.....12. *futilalis* variety.
13. Fuscous; nearly immaculate, or with inconspicuous darker markings.
14. Hind wing evenly dark fuscous, or with a pale postmedial shade.....15. *unifascialis.*
14. Hind wings whitish.....12. *futilalis.*
14. Hind wings paler fuscous, with an even diffuse darker border.....14. *fumoferalis.*
13. Dull olive, immaculate; small, with pointed fore wing.....22. *laticlavia,* variety *cinerosa.*
13. Dark olivaceous, with diffuse pale postmedial band. 15. *unifascialis.*
13. Violet-gray with yellow costo-apical bar. 24. *angustalis.*

1. **P. pertextalis** Lederer. Cream-white; markings light gray-brown, clean-cut; postmedial line hardly waved, sinuous; subterminal clean-cut, contrasting, deeply dentate; orbicular a distinct ring, reniform a double bar (unlike *Crocidophora serratissimalis*, which is superficially very similar); some light brown streaks on veins, and also between them along outer margin; terminal line continuous, dark brown. Hind wing closely similar. Discal dot practically obsolete on under side, distinct above. 20–28 mm. (**H 47**:54.)

Two broods, flying mainly in June and August.

General in distribution; not rare. New York: Fentons, Honeoye Falls, vicinity of Buffalo, Ithaca, Big Indian Valley, Albany, New Windsor, New York City; Lynbrook, Long Island.

P. gentilis Grote appears to be the name for the smaller yellower specimens, with clean-cut markings; feeding on Erigeron. Large variants of this type, approaching *P. thestialis* and *P. fissalis*, have been bred from Ilex and Clethra.

2. **P. thestialis** Walker. Markings as in *P. pertextalis*, ground paler, with decided violet iridescence; orbicular and reniform often filled with brown, contrasting; terminal space often suffused with brown, slightly paler than the subterminal line. Hind wing with a blackish discal spot, contrasting below as well as above. 28–35 mm.

Very close to the preceding species but apparently distinct. June and July. Larva on Corylus, linden, and Euonymus.

Generally distributed. New York: Mt. Marcy, Lewis County, Lewiston, Ithaca, Karner, Rhinebeck, Katonah, New Windsor.

3. **P. fissalis** Grote. Ground nearly pure white. Pattern as in *P. pertextalis*, but more or less broken up into arrowhead marks on the interspaces. Discal spot on hind wing distinct above, completely absent below, except as it shows by transparency. 25–30 mm.

Larva on sassafras and goldenrod in late May; long, fusiform, grayish yellow, shining; tubercles large, shining, brown-stained around the edges; ia and ib of thorax partly fused. Head and cervical shield pale brown. Pupa in a slight web in crumpled leaves. Moth from June to August; commonest in July.

Atlantic States north to Maine. New York: Otto, Ithaca, Utica, Little Falls, Catskills.

4. **P. æglealis** Walker. Cream color, heavily shaded with dull brown; often with only the space between the reniform and orbicular spots pale, and a rather clearly defined pale shade beyond the postmedial line; in light specimens with the subterminal line represented by a vague dark shade. Veins more or less dark-streaked; terminal line usually marked by a series of darker dots. Discal dots of fore wing above simple, of hind wing below nearly obsolete. 30 mm.

Larva on Phytolacca; also reported from Osmunda, possibly confused with *P. theseusalis*. Moth from June to August; common in July.

General in distribution. New York: Buffalo (VanDuzee), Liberty (Morton), Ithaca; Bucks Hollow, Staten Island.

5. **P. langdonalis** Grote. Cream color; antemedial line obscure; postmedial line merely the boundary of the very broad dark brown subterminal space, normal in course. Reniform a thick spot. Outer margin narrowly cream color. Hind wing with a similar smaller discal dot, and equally broad border. (**H 47**:52.)

Late June and July.

New Jersey to central Illinois, south to Tennessee.

6. **P. flavidalis** Guenée. Pale lemon yellow, shading into cream color, usually bright yellow along the margins; sometimes with only the costal margin bright yellow; markings red-brown, sometimes mixed with blackish; normal, tending to break into spots; the horizontal part of the postmedial line usually absent, and the part of the postmedial from Cu_2 to the inner margin apparently continuous with the reniform. Subterminal line thick, irregularly offset on veins; terminal line fine. 28–35 mm.

Late July to August. Larva a root borer in Vernonia, usually pupating in stubs of plants of the previous year in June.

Long Island, New York, to Illinois and south. New York: Florida, New Windsor, Long Island.

P. oxydalis Guenée, which is similar to *P. flavidalis*, but with heavy, suffused, red-brown marginal markings, is probably confined to the Southern States.

7. **P. submedialis** Grote. Cream color; markings normal, pale grayish, faint; orbicular a small circle, reniform when most distinct, with pale center; no traces of subterminal line. Hind wing whitish with distinct broken postmedial. Under side with a broad gray subterminal band on fore wing; discal dot of hind wing obscure. 25 mm. (*dissectalis* Grote, *pilalis* Hulst.)

Canada; Illinois; Florida; Texas; Arizona.

8. **P. penitalis** Grote. Pale yellow, with contrasting and not very diffuse rusty ochre, rarely grayish, markings and dusting; antemedial line erect, sharply dentate, not running out to inner margin; reniform a slight vertical bar, followed by more or less obvious rusty or grayish streaks or shades; postmedial line fine, moderately dentate, sometimes obscure in female, drawn in below cell as usual, produced out roundly in submedian space, but running in again to inner margin. Subterminal a broad but distinct dentate shade, or, more rarely, a deeply dentate line; hind wing not dark at base; with slight discal bar and even postmedial and terminal shades, the latter slightly paler on the margin, or with the postmedial shade indicated only as the outer boundary of a darker discal area; in the female often with only traces of the middle part of the postmedial line, which is near the end of the cell, unlike the similar, nearly immaculate yellow specimens of *P. inconcinnalis* and *futilalis*. Male with a patch of sex-scaling on inner margin of fore wing below. Juxta with a single, stout, ventrally projecting spur. 25 mm. (*nelumbialis* Smith.)

The larva is aquatic, on water lily and Nelumbo; rarely in other aquatic plants. Pupa without a frontal hump; with cremaster broader than long.

Apparently general in distribution, but obscure and usually misidentified. New York: Lynbrook, Long Island.

9. **P. ainslei** Heinrich. Similar to *P. penitalis;* fore wing without reddish shading and powdering, no sex-patch on inner margin, on under side. Juxta with two slender dorsally projecting arms embracing the ædœagus; apex of uncus rounded. 20–27 mm. (*obumbratalis* Lederer ?)

Larva boring in marsh plants, normally only in Polygonum, but frequently straying to other foods. Pupa with a prominent projecting frontal knob.

Generally distributed; widespread in New York, but local.

10. **P. nubilalis** Hübner (European corn borer). Pattern exactly as in *P. penitalis*; ground brighter straw yellow; male heavily overlaid with brown, leaving yellow areas in the antemedial region, between the ordinary spots, and beyond the postmedial line. Under side of fore wing with a sex-patch, as in *P. penitalis*. Juxta with two dorsal arms, embracing the ædœagus. Uncus trifurcate. Female not certainly distinguishable from the two preceding species without dissection; normally slightly brighter in coloring. 30 mm.

Larva a serious pest in corn and other coarse herbaceous plants; easily distinguishable from the other corn-pests by the tubercle pattern of the genus, with ii much smaller and farther lateral than i; distinguishable from the two preceding species only with the microscope. Massachusetts strain with two broods, and showing a strong tendency to eat a great variety of plants; western strain single-brooded in normal seasons, and practically confined, so far as now known, to corn. Hibernation in the well-grown larva, in the stubble. Pupa without a frontal hump; with cremaster longer than broad. Probably the most serious known corn pest.

Eurasia; recently introduced in eastern Massachusetts; and in the vicinity of Albany, New York, and the Lake Erie basin.

For a full account of these three species see the *Journal of Agricultural Research;* vol. 18, p. 171.

11. **P. illibalis** Hübner, race **arsaltealis** Walker. White, sometimes suffused with fuscous; shaded and spotted with blackish; orbicular a black spot, larger than in those species of the preceding group where it is solid; reniform a narrow vertical blackish bar, often forming the center of a blackish shade; both rarely obsolescent. Ordinary lines absent, terminal line broken into black bars, with a gray bar in the fringe opposite each. Hind wing usually a little suffused with clay color, and normally very lightly dotted with blackish and shaded with fuscous at margin; rarely, with a dark discal bar. 25 mm. (**H 47**:48.)

The typical form, with both wings almost pure white, with very little black or brown dotting, except for the broken black terminal line, and with contrasting large brown orbicular and reniform spots, appears to be confined to the South.

May and June.

Generally distributed north to Hymers, Ontario. New York: Buffalo, Ithaca, Big Indian Valley, New Windsor.

12. **P. futilalis** Lederer. Typically powdery dull fuscous; in the Mississippi Valley race, powdery ochre yellow; markings obscure; postmedial, when distinct, moderately dentate and sinuous, fine and dark; sometimes followed by a paler shade; terminal line often showing two dots to each interspace. Hind wing white, sometimes with traces of the postmedial line far out toward the margin, lightly shaded with fuscous (in the western race ochreous) along the outer margin. 30 mm. (*erectalis* Grote. The yellow form is *penitalis* Hulst, not Grote.)

June.

General in distribution. New York: Peru, Mt. Marcy, Lewis County, Lewiston, Ithaca, Karner (yellow form), Albany, Poughkeepsie, New Windsor.

13. **P. inconcinnalis** Lederer. Orange-ochre, practically immaculate; fore wing and margin of hind wing powdery; base of hind wing slightly paler. 28 mm. (*crocatalis* Grote, *festalis* Hulst.)

Western States; reported from Illinois, probably in error for the yellow form of *P. futilalis.*

14. **P. fumoferalis** Hulst. Powdery ash gray; lines deeply dentate, antemedial erect, postmedial moderately sinuous and followed by a dentate pale line or shade; the margin beyond perceptible darker. Terminal line black, usually broken. Hind wing light fuscous, with an even, slightly diffuse, darker border, often preceded by a pale shade. Veins more or less distinctly darker, often darkening into a series of short postmedial streaks; rarely, with a wavy postmedial line. 30 mm.

Cocoon under bark of hickory; characteristically formed of a fusiform central cocoon enclosed in two or three oval walls. Larva presumably on hickory. Moth in June.

Generally distributed; south to Pennsylvania and Illinois and west to California. New York: Mt. Marcy, Lewis County, Ithaca, Schenectady.

15. **P. unifascialis** Packard, race **subolivalis** Packard. Dull olivaceous, powdered with cream-white on dark brown, with a more or less distinct, light, moderately sinuous postmedial band, parallel to outer margin, not bent in at all below cell, defined on inner side, diffuse on outer; sometimes obsolete, and sometimes very conspicuous. Sometimes with a more or less distinct pale patch in outer part of cell, the other markings obsolete. Hind wing duller, without greenish tint; with or without an irregular pale postmedial shade or bar, sometimes defined with a darker line on inner side. 20–25 mm. (*hercynalis* Grote, *obnigralis* Hulst.) (**H 47**:51.)

June to July.

Maine to Illinois, and south to New York; the typical form in California. New York: Peru, Axton, Fentons (Lewis County), Lancaster, Liberty, Portage, Potter Swamp (Yates County), Ithaca, Big Indian Valley, Karner, Nassau, Rhinebeck, New Windsor.

16. **P. fodinalis** Lederer. Outer margin straighter than usual in the larger Pyraustas, often a little concave; apex marked. Fore wing light ochre, often shaded with olivaceous or reddish; orbicular a gray dot, reniform an oblong patch. Antemedial excurved, and waved; postmedial finely dentate, running in along Cu_2 to before end of cell, very fine, gray; a broad gray subterminal shade from apex to anal angle, concave on outer side, sometimes wanting. Hind wing with a straight subterminal shade from near apex, usually fading out toward anal angle; postmedial line usually short and straight or absent. 20 mm. (*socialis* Grote.)

Wisconsin and west; rare eastward. New York: Lewiston, Lancaster, Buffalo, Ithaca, Big Indian Valley, Onteora Mountain.

17. **P. phœnicialis** Hübner. Bright straw yellow. Fore wing with a nearly marginal light brown or crimson border, reaching in almost, but not quite, to postmedial line, nearly even in width; postmedial very fine, deeply sinuous, and curving in below end of cell, but not dentate; brown, with a brown shade between it and end of cell and usually before it to inner margin; orbicular a gray dot; reniform a vertical lunule; antemedial line fine, excurved, with more or less brown shading before it. Fringe gray, or more or less yellow. Hind wing concolorous; border similar; postmedial nearly straight from costa at two-thirds to near anal angle, sometimes preceded by a brown shade. Beneath, with costa gray or crimson, extending across cell on basal half and at end, leaving a square yellow patch. Outer margin also dark. 15 mm.

Larva on apple.

Hemlock Falls, New Jersey; Florida. "New York" (Walker).

Variety **flegialis** Walker is larger and more deeply and richly colored, with a pale costa below. Various other varieties occur.

18. **P. onythesalis** Walker. Fore wing about as in *P. phœnicialis*, the brown usually lighter and grayer; the fringe, and often a little of the outer margin, pale yellow, often crossed by a deep red, broken terminal line. Hind wing pale yellow with a fine straight postmedial line running to the outer margin near the anal angle, and a broad purplish terminal band, tapering off below. Fringe yellow. 20 mm. (probably *insignatalis* Guenée; *phœnicialis* auct., in part, not Hübner.)

Larva perhaps on Salvia.

Illinois; Missouri; Texas; Arizona.

19. **P. acrionalis** Walker. Base mixed rose or light violet and light yellow, the lines and orbicular and reniform spots violet, partly obliterated by the violet shading; postmedial region from postmedial line almost to margin, solidly rose or violet, leaving a narrow pale yellow terminal band, and yellow fringe, sometimes separated by a broken red terminal line. Under side dark. Hind wing typically whitish, shading into gray toward outer margin; with some violet iridescence; in variety **rufifimbrialis** Grote mostly or wholly gray, usually with a fine clear yellow postmedial line; in variety **haruspica** Grote and Robinson with a dark fringe. 18 mm. (*phœnicialis* auct., in part, not Hübner.)

July to September.

General in distribution. New York: Old Forge, Newport, Speculator, Lancaster, Otto, Ithaca, Big Indian Valley, Utica, Rhinebeck, New York City, Fort Montgomery.

20. **P. ochosalis** Holland (Fitch ms.). Deep purple-brown, with obscure pale markings, defining more or less distinctly the antemedial and postmedial lines; a conspicuous round yellow postmedial patch, not reaching costa; usually with a separate yellow costal dot at its upper outer angle. Margin and fringe dark. Hind wing blackish with a broad postmedial yellow band. 18 mm. (**H 47**:57.)

June to August.

Quebec to Arizona; a yellower variety in California. New York: North Elba, Oak Orchard Swamp, Ithaca.

21. **P. generosa** Grote and Robinson. Deep brown; postmedial yellow patch higher than wide and running through to costa, and sometimes narrowly to inner

margin; sometimes with a narrow postmedial line and a distinct yellow spot in cell. Hind wing about as in *P. ochosalis*. 10 mm.

Western Pennsylvania to Illinois and Manitoba. New York: Fentons (Lewis County), Newport, Lancaster, Buffalo, Karner, Sloatsburg. I have verified none of these records, which may belong wholly or in part to the preceding species.

22. **P. laticlavia** Grote and Robinson. Yellow, with a broad even rose-colored border; costa rose, down to **R**; and with a broad median area, of moderate width, constricted somewhat at fold, and containing a small yellow spot in cell. Hind wing duller luteous, with purplish border. 15 mm.

In variety **cinerosa** Grote and Robinson, the yellow is replaced by olive, and the rose by dark purple, or sometimes the whole moth is dull olive.

August.

Southern States, north to Five-mile Beach, New Jersey. "New York" (Grote).

23. **P. tyralis** Guenée. Fore wing typically deep crimson, sometimes fuscous suffused with crimson; an excurved antemedial fascia, and a somewhat sinuous postmedial one, yellow in crimson specimens, edged with crimson or wholly crimson in dark ones; sometimes with a small yellow spot at end of cell. Hind wing orange-red at base, shading into crimson at margin, rarely with a yellow postmedial bar. 15 mm. (**H 47**:44.)

September.

Southern States, north to Missouri and Illinois.

24. **P. signatalis** Walker. Rose pink; the ante- and postmedial lines narrow, pale yellow, and often partly obsolete; antemedial line erect, dentate; postmedial line sinuous and somewhat dentate, the strongest tooth on **A**; sometimes with yellow spots in median area; median area sometimes suffused with gray. Fringe ochreous. Hind wing pale yellowish, with a brownish shade toward margin. 18 mm. (*virulenta* Grote and Robinson.)

May, August and September. Larva on horsemint.

Southern New Jersey and central Illinois to Texas. New York: Lewiston, New Windsor (Morton).

P. angustalis Grote is rather darker crimson, shaded with brownish gray; the ordinary lines are more reduced; usually with only a short straight whitish postmedial bar on costa at three-fourths way to apex. The hind wing is mostly brownish gray, with dark fringe. This species appears to be purely western.

25. **P. inveterascalis** Barnes and McDunnough. Evenly powdered with blackish on a dull crimson base. Costa more solidly crimson, antemedial line fine, pale yellow, zigzag, stopping at vein **R**; postmedial perpendicular to costa, parallel to outer margin below, fine, yellowish, often reduced to scattered scales except for a yellow bar at costa. Margin and fringe narrowly yellow. Hind wing duller, without red; with a pale postmedial line from middle of M_2 to near outer margin at Cu_2, then angled and faintly extended toward anal angle. Below, dark fuscous with a pale margin and a postmedial costal dot on the fore wing; and with a postmedial shade and basal shading on hind wing. 15 mm. (*angustalis* of collections, not Grote.)

June and July. Only types seen.

New Brighton, Pennsylvania.

26. **P. nicalis** Grote. Fore wing fuscous, with a slight dull purple tinge; postmedial line narrow, contrasting, whitish, moderately sinuous, twice as wide at costa and at inner margin as at middle, sometimes practically interrupted at middle, antemedial usually absent. Hind wing duller fuscous, with somewhat darker outer margin; postmedial line somewhat waved, erect, approaching outer margin near anal angle. 22 mm.

July.

Hymers, Ontario, to Colorado and California.

27. **P. unimacula** Grote and Robinson. Mouse gray, with a large pale yellow postmedial patch, resting on costa; sometimes with a trace of the postmedial line on its outer side. A small yellow dot in fold. Hind wing similar, the whole median area yellowish. 18 mm. (**H 47**:56.)

End of May to August.

New York to Illinois and Florida. New York: Ramapo, Brewster's (Grote).

28. **P. subsequalis** Guenée. *Typical female*: fore wing ranging from ochre yellow to dull orange; antemedial line wavy; postmedial sinuous, and widened into a series of black wedges; both lines rather thick and somewhat irregular; large black orbicular and reniform spots; subterminal a broad shade, narrowed or interrupted in middle; often with a blurred blackish median line, or the median area somewhat suffused with blackish. Hind wing bright orange, with a large black discal dot; two outer black bands parallel to outer margin, and some longitudinal streaks on basal half of wing along **Cu** and the anals. Fringes black. *Typical male*: fore wing suffused in two shades of fuscous, and scaled with dull red; with traces of the markings of the female; the hind wing black, with short postmedial and terminal orange lines only. 20 mm. (*insequalis* Guenée.)

Larva on thistle. Moth in June and late July.

Northern New York to Illinois and south. New York: Black Brook (male).

The northern variety **borealis** Packard, is a little smaller than the female of the preceding form, with the same markings: fore wing light ochreous and fuscous; hind wing yellow, with the basal half almost solidly fuscous, obscuring the discal dot; outer markings rather light. Nova Scotia to British Columbia.

Specimens from Massachusetts, New York, etc., are generally intermediate, with the sexes similar, but with the base of the hind wing orange with gray streaks as in *subsequalis*. These are var. **madetisalis** Walker (*efficitalis* Walker.) (**H 47**:41.)

April to July.

Generally distributed and not rare locally. New York: Black Brook, Saranac Lake, Ithaca, Big Indian Valley, Ilion, Schuyler, Nassau, Rhinebeck, New Windsor, Suffern, New York City; Tottenville, Staten Island.

29. **P. funebris** Ström. Black. Tegulæ yellow. Two large rounded pure white spots on each wing. Fore wing often with a third small spot below the costa between the two large ones; abdomen finely striped with white. 20 mm. (*octomaculata* Linnæus.) (**H 47**:50.)

June and July. Larva light yellow-green, with yellowish head; living on the under side of the basal leaves of Solidago.

Generally distributed northward, south to New Jersey at least; Eurasia. New York: Common and generally distributed.

30. **P. niveicilialis** Grote. Dark, smoky gray, nearly black, with a pale postmedial shade, usually distinct only near the costa; fringe white, contrasting. Hind wing black, with white fringe. 22 mm.

May and June; August.

Canada to northern New Jersey, Pennsylvania, and Colorado. New York: Crosby (Yates County), Ithaca, Albany, Poughkeepsie, and New Windsor.

31. **P. inquinatalis** Zeller. Palpi moderate, tibial spurs normal. Pale powdery gray, shaded heavily with dark gray at base and outer margin. Antemedial line hardly one-fourth way out, slightly outwardly oblique and dentate; postmedial line blackish, finely dentate, and slightly excurved from costa to Cu_1 then in to below end of cell, where it forms a dark bar, and out again on **A**; below **A**, about in line with its position above, two-toothed. A pale shade between the postmedial line and the dark border. Costa more or less gray shaded; orbicular a gray patch, reniform kidney shaped, and dark gray, separated from orbicular by its width. Hind wing paler toward base, with a waved weak postmedial line; discal bar and dot at lower angle of cell, and dark border. 20 mm. (*glacialis* Packard; *Phlyctænia* auct.)

May to July. Male unknown to me.

Ottawa, Ontario; Labrador; Europe.

32. **P. demantrialis** Druce. Antennæ rather thick and rough-scaled at base. Front strongly oblique, but without a cone; palpi rather long; fore wing with R_5 more curved than usual, the wings narrow and subfalcate. Upper outer spur of hind tibia of male only one-fifth the length of the inner.

Fore wing shining lead gray, immaculate, the basal half overlaid with black-tipped whitish scales. Hind wing somewhat paler toward base, not powdered. 20 mm. (*Blepharomastix* Druce; *Bœotarcha* Hampson; *chalybealis* Fernald manuscript.)

July and August.

New York, to Arizona, south to Central America. New York: Ithaca.

P. singularis Lederer, from "North America," is probably a stray from the tropics. It is described as flesh color with a black tuft at basal angle. 33 mm.

P. venalalis Hulst and *abdominalis* Zeller are unknown to me; by the original descriptions the first suggests *Loxostege helvialis*, and the second *P. fissalis*. *Torvalis* and *marginalis* have been treated as *Titanios*.

48. *LOXOSTEGOPSIS* Dyar

Wings as in Pyrausta; Sc and R of hind wing rarely approximate, instead of anastomosing (fig. 325). Palpus beak-like, extending barely its length beyond the head; maxillary palpi large and triangular, filling the space above the labials. Tongue weak, typically obsolete.

This may be the primitive genus of Pyraustinæ, but in our present uncertainty as to Pyralid evolution, I shall not disturb the customary order to put it at the head.

1. **L. merrickalis** Barnes and McDunnough. Brown-black; ante- and postmedial lines darker, obscure on the dark ground, the postmedial sinuous. Head and top of palpi clay yellow, contrasting. 15 mm. (*Pyrausta* Barnes and McDunnough).

July.

New Brighton, Pennsylvania. New York: Ithaca.

49. *THELCTERIA* Lederer

(*Eustixia* Hübner?)

Palpi rather long and porrect obliquely, the third segment not long but well marked and porrect; much shorter than in Scoparia. Maxillary palpi very large and broadly triangular, as in Scoparia; front with a conical prominence; wings broad with normal venation; all veins spaced.

This genus is possibly an aberrant Scopariine.

1. **E. pupula** Hübner. White with about ten jet-black dots, some of them, rarely, partly fused into ante- and postmedial lines; one spot basal, two terminal, and one representing the reniform. Hind wing white, or with slight fragments of postmedial and subterminal lines. 15 mm. (**H 47**:58.)

Locally common all season.

Massachusetts to Texas. New York: Poughkeepsie, New Windsor; Brooklyn, and East New York, Long Island.

Octonalis appears wholly unrelated, and is removed tentatively to Lygropia.

Lineodes integra Zeller, easily recognized by its entirely Pterophorid appearance of wings, body, and legs, is a western species ranging east to Missouri. The larva is pale green with a pale brown head and black spots on either side of the prothorax. It webs the leaves of *Solanum nigrum* and other Solanaceæ.

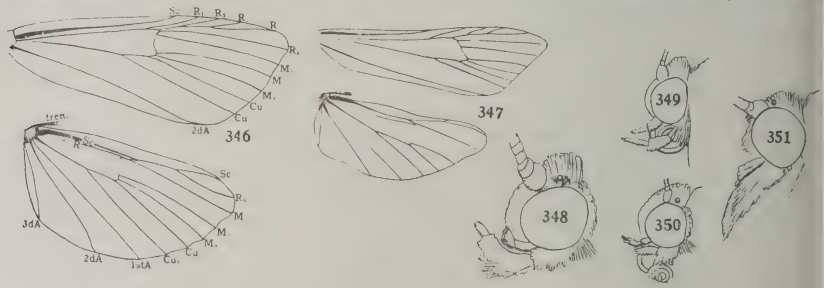
Subfamily **NYMPHULINÆ**

(Hydrocampinæ)

Similar to the Pyraustinæ, except for the usual stalking of R_2 with R_{3+4} (fig 346). Maxillary palpi always well developed (figs. 348 to 351); labial palp normally upturned with well-marked segments, and a good-sized third segment

Caterpillars of all our known native species aquatic, forming some sort of a case or shelter; frequently with tracheal gills, and spiracles reduced. Lateral setæ on ninth segment of abdomen obscure, and i close to iii; hooks arranged in a complete ellipse, alternately of two lengths.

Those caterpillars without gills show no single difference from the Pyraustinæ



FIGS. 346–351. NYMPHULINÆ

346, *Nymphula icciusalis*, venation; **347**, *Elophila fulicalis*, venation; **348**, *Nymphula gyralis*, side view of head; **349**, *Elophila fulicalis*, side view of head; **350**, *Geshna* (?) *primordialis*, side view of head; **351**, *Diathrausta reconditalis*, side view of head

The pupæ are very thin-skinned, and often with spiracles of two sizes, only the larger ones being functional. The cocoon is filled with air even in those species that breathe water in the larva; but is often completely submerged. So far as known to me the species are two-brooded, hibernating under water as part-grown larvæ. Some may feed a little through the winter.

Key to the genera

(*Imago*)

1. Hind wing with a vein lost (M_2).
   2. Palpi porrect (fig. 351) (black species) ..... 52. **Diathrausta.**
   2. Palpi upturned (fig. 349) (light species) ..... 51. **Elophila,** in part.
1. Hind wing with all veins preserved.
   2. Palpi porrect, with scaling continuous on second and third joints; terrestrial ..... 54. **Eurrhypara.**
   2. Palpi obliquely porrect, with well-set-off segments (fig. 350); tongue extremely stout, much thicker than palpi; in wet places, but probably not aquatic ..... 53. **Geshna.**
   2. Palpi upturned, with strongly curved second joint, and close-scaled third, well set off; aquatic.
      3. Maxillary palpi regularly tapering to apex (fig. 349); outer margin of hind wing with a metallic and black border extending to Cu_2. 51. **Elophila,** in part.
      3. Maxillary palpi somewhat broad-scaled at tip (fig. 348); outer margin of hind wing with, at most, a few small black dots opposite lower angle of cell ..... 50. **Nymphula.**

(*Larvæ*)

1. Aquatic.
2. Without tracheal gills.
3. Case ovate, on Lemna.....51. **Elophila.**
3. Case sharp-edged, on other plants.....50. **Nymphula.**
2. With simple tracheal gills, under a web on rocks.....51. **Elophila.**
2. With branching tracheal gills, in a floating case
50. **Nymphula (Parapoynx).**
1. Terrestrial, on nettle.....54. **Eurrhypara.**

50. *NYMPHULA* Schranck

(*Hydrocampa* Latreille, *Parapoynx* Hübner, *Paraponyx* auct., *Oligostigma* Guenée, etc.)

Palpi obliquely upturned, with second joint well set off and rather broadly scaled, third conical, much slenderer, and nearly as long (fig. 348); maxillary palpi rough-scaled, and truncate at tip or triangular; large, except in *N. ekthlipsis;* tongue not very strong; ocelli small, but present. Antennæ usually annulate, with the outer row of scales on each segment raised; legs long and slender.

Fore wing (fig. 346) with R_1 free, R_2 usually stalked, free in odd specimens of several species; R_3 free, divergent; hind wing with Sc and R fused a considerable distance, the other veins free; M_2 and M_3 approximate at base. Sexes often strongly dimorphic in size and markings. Female with exserted ovipositor.

Caterpillar aquatic, in a case, or under a piece of a leaf cut out and attached to the surface of the leaf (when a case is made, it is of two pieces of leaf, and has sharp edges). Larva often with branched tracheal gills, and breathing water. Pupa in the case, which is more heavily lined with silk than while used by the larva, and in the species whose larvæ breathe water, is emptied of the water.

Key to the species

1. Hind wing wholly white, or with one or two faint lines.
2. Fore wing yellow or brown, markings on hind wing more distinct.
4. *gyralis,* in part.
2. Fore wing mouse gray, or white, or gray and white with a contrasting pattern; hind wing usually immaculate.....5. *maculalis.*
1. Hind wing with diffuse gray lines, with diffuse grayish discal spot.
4. *gyralis,* in part.
1. Hind wing with two fine, closely parallel, wavy black lines.....9. *allionealis.*
1. Hind wing with two even and parallel mesial bands.
2. Fore wing dominantly white.....8. *badiusalis.*
2. Fore wing coppery and gray, with broad even white postmedial fascia.
6. *seminealis.*
2. Fore wing dull fuscous brown, with a narrow wavy postmedial white line.....7. *obscuralis.*
2. Fore wing largely coppery, with obscure pale postmedial band, or none; with four black enlarged dots on outer margin of hind wing.
6. *seminealis* ♀.
1. Hind wing with two irregularly waved black lines, with a yellow discal spot between them.
2. Discal spot edged with black.....1. *ekthlipsis.*
2. Discal spot not dark-edged.....2. *icciusalis.*
1. Hind wing blackish with obscure markings.....3. *obliteralis.*

Larvæ

1. With tracheal gills.
   2. Anterior and posterior infrastigmatal gills with the same number of filaments (five when full-grown) ..... 5. *maculalis*
   2. Posterior subdorsal and infrastigmatal and pedal gills with the same number of filaments; anterior infrastigmatal with one less.
      3. Maximum number of filaments in last stage six; usually feeding on Vallisneria ..... 7. *obscuralis*
      3. Maximum number of filaments four; usually feeding on Limnanthemum ..... 6. *semineralis*
1. No tracheal gills; second abdominal spiracle decidedly smaller than third; caterpillar stout and flattened, with head darker than body.
   2. Head dark chitin-yellow; case nearly circular.
      3. Body whitish; thoracic tubercles more distinct than abdominal ones; head with a lateral brown stripe; on Potamogeton ..... 3. *obliteralis*
      3. Body pale yellow; tubercles all similar; head with dark spot confined to mouth parts; on Nuphar ..... 4. *gyralis* (?)
   2. Head dark brown, body dirty gray; in an oblong case on Potamogeton and probably Menyanthes ..... 2. *icciusalis*
   2. Head not noted; larva on sedge ..... 1. *ekthlipsis*

I. *Larva without tracheal gills, breathing air; the case full of air; pupa with first open spiracle smaller than the other two; moth with fore wing typically subfalcate;* Sc *separating from* R *halfway between cell and apex, the free part at least two-thirds as long as free part of* R; *palpi normally hairy below; antemedial line of hind wing crossing cell perpendicularly* (Hydrocampa, Nymphula).

1. **N. ekthlipsis** Grote. Maxillary palpi smaller than in the other species; half as large as third segment of labials; fore wing subfalcate. White, with three confused bands on basal half, the outer one angled out on **Cu**, and touching the lower end of the large kidney-shaped reniform; postmedial band yellow, its inner margin running in a curve from costa to lower outer angle of reniform, and in a shorter curve from inner angle of reniform to inner margin, with the lower part of the antemedial band enclosing a circular white spot. Subterminal band white; all the markings heavily edged with brown, sometimes largely covering the yellow; subterminal line brown, closely parallel to margin, followed by a light brown and yellow stripe and white fringe. Hind wing similar, the basal marks replaced by a straight antemedial band, edged outwardly with dark brown. 18–25 mm.

Larva in an oblong case on sedge.

General but local, south to New York and Illinois. New York: Ithaca, Michigan Swamp (Tompkins County), Albany.

2. **N. icciusalis** Walker. Yellow or brown, shaded with silvery white; base with considerable white; a white triangle at middle of costa with a black bar on its front edge; a white discal crescent, edged outwardly with black; a white circle in middle of fold, strongly outlined with black, and variable in size; subterminal line strongly irregular, sometimes edged outwardly with black, at least toward apex; fringe barred, brown and white. A fine white postmedial line following the outer edge of the reniform lunule and the circle on the fold. Hind wing similar; antemedial band as in *N. ekthlipsis*, postmedial line irregular, edged before, and sometimes beyond, with black; discal spot large, yellow; subterminal line as on fore wing. Ground of basal two-thirds white, of outer third, yellow or brown. Ground rarely both yellow and brown, the region beyond the cell, and the base of the fore wing being contrastingly light; white and black markings of the fore wing sometimes suffused. 12–20 mm. (*formosalis* Clemens, *genuialis* Lederer.)

Caterpillar in an oblong case on Potamogeton, sedge, Lemna, Menyanthes, and other aquatic plants. Cocoon sometimes anchored under water. Moth in August.

Common everywhere, flying over the water and along the shore of ponds. New York: Saranac Lake, Saranac Inn, Lancaster, Otto, Potter Swamp (Yates County), Ithaca, Big Indian Valley, Nassau, Rhinebeck, New Windsor.

3. **N. obliteralis** Walker. Fore wing not falcate. Dull black, obscurely marked with ochre and a little white, with obscure light blue iridescence; hind wing similar, or almost completely suffused with black; discal lunule white on both wings. Female lighter, browner, with more diffuse markings, and much larger; discal lunule often very weak. 10–16 mm.

Larva on water lilies (Nymphæaceæ); sometimes a minor pest in greenhouses.

Quebec, and south; common southward. New York: Hemlock Lake, Rhinebeck. (Usually a greenhouse pest northward, but the Hemlock Lake specimens, at least, were taken outdoors.)

4. **N. gyralis** Hulst. Male fuscous or light brown; base a little darker, bounded by a waved white line; costal triangle a white outline, filled with blackish and edged with white, the outline often broken; reniform lunule a curved black line, edged with white and often connecting with a short black and white subterminal streak on costa; subterminal line white, irregular, edged with brown. Hind wing white, with vague fuscous ante- and postmedial lines, often fusing on dorsal half of wing; postmedial line followed with white, and strongly irregular; discal spot vague, grayish; subterminal line as in fore wing, in a brownish or yellowish shade. Female with markings the same as far as traceable; ground lighter brown, or dirty yellow, the markings often suffused; hind wing white with slight gray markings. 20 mm.

General, but relatively rare; larva on water lily.

New York: Big Tupper Lake, Saranac Lake, Lewiston.

In southern specimens portions of the ground are light ochre yellow; northern ones are usually wholly fuscous brown and white.

II. *Larva with tracheal gills, two subdorsal, two subventral, and a pedal pair on most segments; the subventrals with an equal number of filaments; second and third abdominal spiracles equal, all very small; case filled with water; pupa with the three open spiracles equal in size, with a median longitudinal carina on ninth segment of abdomen. Imago with venation as in the last group; palpi merely rough-scaled; hind wing immaculate, or with a faint postmedial line only* (Nymphæella *Grote*).

5. **N. maculalis** Clemens. *Normal male.* Fore wing not falcate; maxillary palpi rough and larger than third segment of labials; fore wing white, marked with dark gray, leaving the white mostly as ante- and postmedial patches in the fold; a vaguer one in the outer part of the cell, and two confluent ones near the outer margin. All the patches connected in light specimens; in dark ones only the two on the fold contrasting. Hind wing white, sometimes with a gray postmedial line on dorsal part. *Normal female.* Fore wing immaculate mouse gray, and hind wing white; much larger. 18–25 mm. (*seminivella* and *dispar* Walker.)

Caterpillar on the water lilies, and rarely on Brasenia; in the last stage, with five filaments on the posterior subdorsal and all subventral gills of most segments, the anterior subdorsals usually with four. First stage without gills, and the intermediate stages with smaller numbers of filaments. Caterpillar immaculate, transparent till just before pupation, then turning yellow; pupa generally under a piece of leaf on a floating lily pad.

Common and generally distributed, flying over water. New York: Saranac Lake, Big Tupper Lake, Lewis County, Spencer Lake.

The male variety **feminalis** Dyar, is dark gray, with obscure markings, muc like the female; the female variety **masculinalis** Dyar is white with only trace of dark markings; the female is rarely brown, and often has a pale costa.

III. *Larva as in the last group, but with one less filament on anteric than on posterior infrastigmatal gills; pupa as before. Imago with palp merely rough-scaled;* **Sc** *and* **R** *of hind wing fused decidedly more than hal way to apex; the free part of* **Sc** *not more than half as long as* **R** *and some times very short; apex of hind wing more or less distinctly truncate. Ant medial line of hind wing strongly oblique, parallel to postmedial line, cuttin across end of cell.* (Parapoynx, Oligostigma.)

6. **N. seminealis** Guenée. Male whitish, powdered with dark brown, giving chocolate brown effect. Outer line broad, even and white, strongly contrasting nearly straight from costa to fold, then turning inward almost to middle o wing; preceded by an equally wide band of brilliant bronze. Subterminal spac bronze, terminal space tawny; subterminal line grayish white and black. Femal similar, but less brilliantly bronzy; postmedial line gray, inconspicuous. Hin wing with a narrow inner and broader outer line, and a bronzy band; severa small black marginal dots in a group, below apex. 20–30 mm.

The caterpillar feeds on Limnanthemum, and perhaps Potamogeton. In th second stage it forms a trumpet-shaped mine on the lower surface of the leaf and then has simple gills; the number of filaments gradually increasing to fou in the last stage. The caterpillar eats more or less of the parenchyma within the case. This species doubtfully distinct from the South American *N. junceali* Guenée.

Massachusetts to Florida.

7. **N. obscuralis** Grote. Ground color whitish, powdered with black-brown as in the male of *N. seminealis*, but much less brilliant, the powdering forming a darker median shade; postmedial line white, narrow in female, broader in male more or less toothed in, below cell in female, and often obsolete below M_3. Sub terminal space a little warmer brown, hardly contrasting. Hind wing marke as in *N. seminealis*, but entirely without bronze reflections; the black margina points not emphasized below the truncation. 20–38 mm. (**H 48**:10.)

Caterpillar with a maximum of six gill-filaments; on Potamogeton and Val lisneria.

Generally distributed. New York: Waddington, Potter Swamp (Yates County) Ithaca.

8. **N. badiusalis** Walker. White; base of costa blackish; a short oblique dark antemedial band; a postmedial band running from costa two-thirds way out perpendicularly down to **Cu**, then in along lower edge of cell to before middle o wing, and obliquely into inner margin; the band grayish, normally partly fille with yellow. Subterminal band yellow, edged with brown, roughly parallel t outer margin, running almost to inner margin, then turning in along the inne margin a quarter way to the base; marginal band yellow, edged within with brown; fringe pale. Hind wing with parallel antemedial, subterminal, and terminal bands, of nearly equal width, the two outer heavily filled with yellow. Male usually smaller, the subterminal band of both wings usually black, emphasized and contrasting; only the marginal band yellow. 15–20 mm. (*albalis* Robinson).

Moth in August. Early stages unknown.

Common north of West Virginia and Illinois.

New York: Saranac Lake, Waddington, Lake Bluff, North Fairhaven, Buffalo, Hemlock Lake, Ithaca, Rhinebeck, Ulster County (Dyar).

9. **N. allionealis** Walker, race **itealis** Walker. Fore wing white to luteous, with fine fragmentary black markings; hind wing white or slightly shaded with lute-

ous; with from two to four fine irregular parallel black lines, the outermost when present, parallel to outer margin. 14–18 mm.

The typical form, from Florida, is much darker.

The caterpillar is unknown. The moth is near to the European *N. stratiotata*, which eats submerged plants and has one more filament in the posterior subdorsal gills, than in the infrastigmatals.

Massachusetts to Florida.

51. *ELOPHILA* Hübner: Tentamen

(*Cataclysta* Hübner, *Chrysendeton* Grote, *Anydraula* Meyrick)

Labial palpi about as in Nymphula; maxillaries more slender, tapering to a point (fig. 349); antennæ annulated; ocellus obscure or absent. Fore wing (fig. 347) subfalcate, with oblique sinuous outer margin; R_2 always stalked in the American species (free in group Anydraula). Hind wing with **Sc** and **R** fused halfway to apex; M_2 free and normal or obsolete (not fused with M_3, as the position of the spots shows). Hind wing always with a marginal chain of metallic and black spots, from apex to Cu_2 in our species. Caterpillar typically an air breather; in an ovate case of Lemna leaves; feeding on Lemna; cylindrical and moniliform; with head yellow, paler than the grayish body; with spiracles functional, and those of third to fifth segments of abdomen enlarged. Larva of *E. fulicalis* under a silk web, on the surface of stones in swift-flowing brooks; feeding on the diatoms and other microscopic forms, growing in the neighborhood of its web or caught in it; with simple tracheal gills, and breathing water. Pupa in *E. fulicalis* in the web, which is strengthened, and whose openings are arranged to catch the air bubbles carried down by the water.

Key to the species

1. Hind wings with one or two black lines beyond cell.....3. *bifascialis*.
1. Hind wings with a black-dusted area beyond cell, and no lines.
   2. Fore wing with a crescentic submarginal spot, not reaching apex, and two or three rounded spots.....2. *medicinalis*.
   2. Fore wing with a submarginal streak broadening toward costa, without contrasting rounded spots.
      3. Black spots of the terminal series on hind wing opposite each other in pairs, between veins .....1. *magnificalis*.
      3. Black spots alternating, the inner series on the veins.....4. *fulicalis*.

1. M_2 *preserved; larva air-breathing; on* Lemna (Elophila).

1. **E. magnificalis** Hübner. Fore wing silver white, with light gray-brown lines; costal region shaded with gray; with a waved diffuse antemedial band and irregular postmedial lines, leaving a rounded or quadrate white area on middle of inner margin; three outer gray streaks, converging to a gray patch at anal angle. Hind wing with a gray antemedial shade and bar across cell; postmedial region broadly dusted with black-tipped scales; five marginal ocellate spots between veins, enclosed with yellow, and with a gray marginal streak below the last one. 18–23 mm. (*lamialis* Walker, *helopialis* Clemens.)

July.

Quebec to Pennsylvania. "New York" (Grote).

2. **E. medicinalis** Grote. Brownish gray; a large obliquely oval antemedial patch, resting on inner margin; a more rounded oval median patch, its apex resting on inner margin, frequently with a small white streak beyond it on inner margin; a white postmedial streak from costa at two-thirds, almost to anal angle; and a crescentic submarginal white streak, narrowing more or less to costa, and usually

not reaching it; a yellow marginal stripe, edged with gray, and sometimes othe yellow streaks and shades between the white spots. Hind wing white on oute half, fuscous on basal half, the boundary a straight perpendicular brown ban followed by a lead-colored line; postmedial region irregularly black-dusted. Ocel late marginal spots confluent, with excentric blue pupils, lying below the veins preceded by a white band and followed by a series of bright yellow bars. 12 mm (*claudialis* auct., not Walker.)

July.

District of Columbia to Illinois and Missouri, and south.

II. M_2 *lost, cell longer* (fig. 347); *larva in a web on submerged stones; with trachea gills* (Argyractis *Hampson, in part*).

3. **E. bifascialis** Robinson. White, lightly dusted with black; base of costa dark shaded; a broad dark vertical fascia just before middle, followed by a parallel darl line; apical region with three broad dark fasciæ, tapering and converging to ana angle, the first broader, darker, irregular, and bisected by an oblique white or silve crescent. Markings sometimes almost wholly yellow, sometimes gray-brown, witl more or less yellow scaling, especially in the two outermost bands. Hind win with a broad transverse lead-gray fascia in the middle, ending abruptly at the fold preceded by a shorter yellow fascia, and the latter usually by a lead-gray bar; a oblique black bar halfway between cell and apex; in the variety **kearfottalis** Dyar divided into two striæ. A marginal waved lead-colored line, partly broken int spots, preceded and followed by alternating black spots; the inner on the veins an much the larger, the outer alternating with yellow bars. 12–15 mm.

August and September. The variety is only known from the Southwest.

New York to Wisconsin and south. New York: Waddington, Honeoye Falls Ithaca.

4. **E. fulicalis** Clemens. Fore wing gray-brown; an antemedial shade, oblique inward, and a median line parallel to it; a short white bar before anal angle; a pale shade in end of cell; a white perpendicular line from costa at two-thirds, an a similar subterminal line, converging to a point above anal angle; a bright yellow terminal line, edged with brown. Median area more or less powdery. Hind win white with a broad curved blackish antemedial band, followed by a finer lin parallel to its outer edge; postmedial region broadly dusted with black scales; marginal markings as in *E. bifascialis*, preceded by a fine line of black scales 10–18 mm. (*angulatalis* Lederer, *confusalis* Walker).

Larva on rocks, as described under the genus; moth in June and early July

Common and general in distribution. New York: Peru, Waddington, Lancaster, Niagara Falls, Jamestown, Honeoye Falls, Ithaca.

There is considerable variation in detail, and more than one species may b included. The names *fulicalis* and *angulatalis* apparently apply to large, rathe pale and evenly brownish-gray specimens, with a continuous fine black line before the marginal lunules of the hind wing; and *confusalis*, to a small form with much yellow shading, a fine black line on the hind wing, widely broken in the middle, and a straighter dark median fascia.

52. *DIATHRAUSTA* Lederer

Palpi porrect, fairly long, triangularly scaled (fig. 351); maxillary palpi triangular, hind wing with one median absent; otherwise like Nymphula.

1. **D. reconditalis** Walker. Brown-black; faint yellowish antemedial and sinuous postmedial lines (white on lower half of hind wing) apparently running directly from the discal dot to above the anal angle; the reniform, orbicular, and claviform, and the discal dot of the hind wing represented by quadrate hyaline white

spots. Fringe with a dark line near base, dark-shaded below middle and at apex. 15–18 mm.

June and July; September.

General. New York: Niagara Falls, Ithaca (aberration with R_2 free), Albany, Pearl River.

2. **D. dæckealis** Haimbach. Similar to *D. reconditalis;* differing in the unbroken median line of the hind wing. Black; a faint white line from costa to middle of wing at three-fourths way to apex, and another evenly curved line across both wings; a large white spot in fringe of fore wing. 13 mm.

June.

Brown's Mills, New Jersey.

53. *GESHNA* Dyar

Our species (which belongs doubtfully to this genus), with palpi oblique, shorter than those of the other Nymphulinæ, the third joint well set off and rather blunt (fig. 350); tongue much thicker than palpi; maxillary palpi large and triangularly scaled; fore wing with R_5 free. Outer margin about as in Elophila. (Typically with R_5 stalked, and the outer margin rounded.)

1. **G. (?) primordialis** Dyar. Fuscous, with the exact pattern of *Blepharomastix stenialis,* but usually without any yellow, or with very little; distinguishable, at last resort, only by the stalking of R_2. 10–15 mm.

Very common in damp places in June and early July.

Generally distributed. New York: Vandalia, Crosby (Yates County), Ithaca, Big Indian Valley.

54. *EURRHYPARA* Hübner

E. urticata Linnæus (*Palpita hortulata*), a black and white European species with yellow thorax; has become established at MacNab's Island, and at Truro, Nova Scotia. The larva is found on nettle.

Subfamily SCOPARIINÆ

Similar to the Pyraustinæ, but with labial palpi porrect and beak-like, and maxillaries large and triangularly scaled, as in the Crambinæ (fig. 354). Fore wing (figs. 352, 353) with more or less distinct raised scaling; with R_{3+4}, R_5, and M_1 more widely spaced at origin than usual in the Pyraustinæ.

55. *SCOPARIA* Haworth

Front flat; antennæ cilate, more or less distinctly annulate; fore wing (figs. 353, 354) oblong with short outer margin, R_5 divergent; hind wing with Sc and R fused, but often for a very short distance, R and M_1 shortly stalked, M_2 stalked. Slender forms with moderately long legs.

Caterpillars (fig. 355) not well known; the group Eudoria found under moss, etc., on trunks of trees; the typical group apparently in roots of Compositæ.

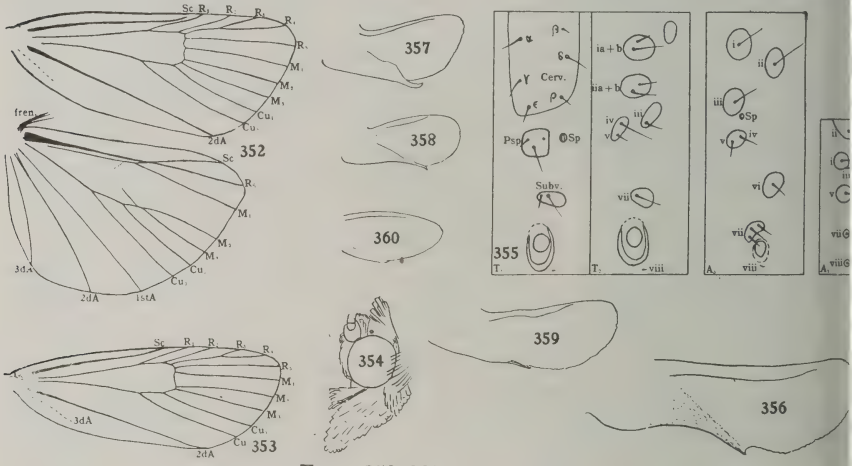
Key to the species

1. Expanse over 15 mm., typically over 25 mm. Fore wing dark, sometimes shaded with gray ..... 1. *centuriella.*
1. Expanse under 15 mm.
   2. Wings fuscous; markings diffuse, partly pale ..... 2. *penumbralis.*
   2. Wings light powdery ash gray, with contrasting dark markings.
      3. Orbicular, claviform, and reniform represented by longitudinal black bars. 5. *strigalis.*

3. Reniform hourglass-shaped, or broken into two wedges; rarely, reduced a dot at lower angle of cell.
4. With a broad, contrasting paler median area.
4. *cinereomedia*, 7. *truncatali*
4. Median area less contrastingly pale (not at all pale in male).
5. Larger; blackish shade beyond antemedial line evener; Cu blac before reniform.....6. *lugubrali*
5. Smaller; blackish shade beyond antemedial line broken below Cu, C not black before reniform.....3. *basali*

I. *Ventral edge of valve not thickened, but bearing a pointed projection near middle uncus tapering, with blunt apex* (Scoparona *Chapman*).

1. S. centuriella Schiffermüller (fig. 352, 356). Varying from light ash gray t nearly black; lines dark, diffuse; the outer one convex opposite cell, pale edged



FIGS. 352–360. SCOPARIINÆ

352, *Scoparia centuriella*, venation; **353**, *S. basalis*, venation; **354**, *S. basalis*, sid view of head; **355**, *S. truncicolella* (Europe), seta map of larva; **356**, *S. centuri ella*, left valve of male, side view; **357**, *S. penumbralis*, left valve of male, side view **358**, *S. basalis*, left valve of male, side view; **359**, *S. cinereomedia*, left valve o male, side view; **360**, *S. lugubralis*, left valve of male, side view. (These five figure are drawn to the same scale from average-sized specimens of the species.)

the inner line often indented on costa; claviform black, linear; orbicular linear o a narrow ellipse; reniform irregular, or broken in two. Dark subterminal shade toward costa and inner margin, sometimes narrowly connected. Hind wing cla color, with blackish border and veins. Female usually darker, sometimes wholl blackish, with obscure markings. 17–27 mm.

Common locally. End of June and July. Caterpillar unknown.

Massachusetts and north, southward in the Rocky Mountains to Arizona. New York: Plattsburg, Peru, Newcomb, Essex County, Saranac Inn, Fentons (Lewis County), Rochester, Buffalo, Ithaca, New Windsor.

II. *Ventral edge of valve with a strong chitinized ridge, ending in a heavy spine; uncus broad, membranous, and hoodlike, but pointed; larvæ apparently root-feeders* (Scoparia).

2. **S. penumbralis** Dyar (fig. 357). Dull powdery gray (black on clay color), the markings formed of the black powdering, diffuse, and evanescent under a lens; antemedial line pale, followed by dark, transverse, well out; postmedial line slightly dentate on veins, excurved opposite lower angle of cell; followed by a distinct pale line, and a vague darker subterminal shade. Reniform a blackish X; orbicular and claviform obsolete; blackish terminal dots, alternating with pale ones. 12–15 mm.

June.

Ontario to Pennsylvania. New York: North Creek, Rock City, Vandalia, McLean.

III. *Valve simple with a slight and slender ventral thickening, usually ending in a less prominent spine, somewhat trapezoidal; uncus membranous, hoodlike, with a blunt, and sometimes bifid apex; larvæ moss-feeders* (Eudoria *Chapman*).

3. **S. basalis** Walker (figs. 353, 358). Powdery ash gray, on white; a blackish basal dash; a strongly excurved antemedial line, with a pale shade before it, and an irregularly developed darker shade beyond; claviform a black dash; orbicular a short bar, separated from the antemedial line by its length; reniform a black cross, sometimes imperfect, more or less shaded with brown; postmedial line strongly and sharply excurved opposite lower angle of cell, almost angled, pale, defined with gray shades, especially on outer side at costa and inner margin; a gray shade along middle of outer margin. Hind wing grayish white. Male with a short small valve, convex on its dorsal side, with a weak, but distinct, spine on its ventral edge, rather near its apex than its base (¼ mm. from apex). 11–16 mm.

June to August.

Generally distributed; common on tree trunks. New York: Niagara Falls, Lewiston, Hemlock Lake, Rock City (Cattaraugus County), Otto, Crosby, Ithaca, Big Indian Valley, Rhinebeck, New Windsor, New York City. I have also unverified records from Essex County, Old Forge, Newport, Fentons (Lewis County), Buffalo, Wells, and Albany, most of which are doubtless correct.

4. **S. cinereomedia** Dyar (fig. 359). Powdery ash gray without any brown; the median area, except beyond the reniform, more or less distinctly paler, sometimes white. Lines as in *S. basalis*, the postmedial perhaps a little less irregular. Antemedial line with its dark outer shade more nearly continuous; the dash in the fold rarely distinct. Male with valve much longer than in *S. basalis*; concave on the upper edge, with the spine weaker, and much further from the apex (nearly ½ mm). 15 mm.

Found with *S. basalis*, in July.

New York and western Pennsylvania. New York: Otto, Ithaca.

5. **S. strigalis** Dyar. Light powdery gray, much like male *basalis;* orbicular, reniform, and claviform nearly equally large, heavy black bars, the orbicular touching the obscure antemedial line, and the reniform a little thicker; a series of black terminal bars, those at apex, opposite cell, and in fold, much heavier; basal dash long. Genitalia not studied. 10–17 mm.

July and August.

Ontario and southern New Hampshire to Georgia. New York: Ithaca.

6. **S. lugubralis** Walker (fig. 360). Very close to *S. basalis.* Outer dark shade of antemedial line continuous, and entirely separate from the rounded claviform spot. Frequently a black bar just above Cu, connecting orbicular and reniform. Postmedial line less deeply angled, but just as sharply. Male with valves long and slender, without a distinct spine on ventral edge. 18 mm.

June to early August.

Bretton Woods, New Hampshire; Canada; Western States.

7. S. truncatalis McDunnough. Similar to *S. basalis*, but without any brow markings, the scaling wholly black and white. Claspers much broader than *S. basalis*. 15 mm.

July.

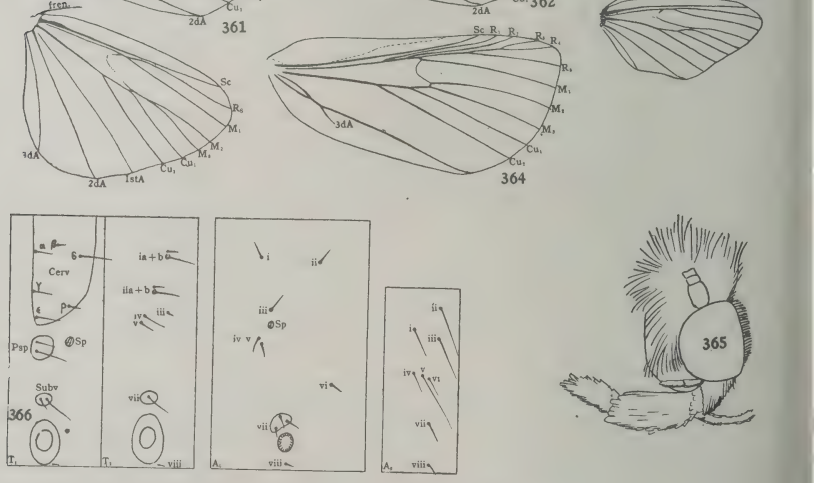
Norway Point, Lake of Bays, Ontario.

This form is obviously distinct from *basalis*, but not distinguishable (on the bas of the single specimen before me) from dark specimens of *S. cinereomedia*, wit which McDunnough does not compare it.

There are probably several other undescribed species of this genus in our terr tory, but they need a full study of the structure and variation, to be worked out.

Subfamily PYRALIDINÆ

Antennæ rarely with modification; ocelli variable, normally concealed or absent antennal socket rarely separated from eye by a line of scales; front nearly smoot (fig. 365); maxillary palpi good sized, but not triangular, and well developed eve when tongue is rudimentary; tongue variable; fore wing (fig. 361) with R_5 stalke with R_3 and R_4; R_2 free; 1st A lost, but represented by a wider space between C



FIGS. 361–366. PYRALIDINÆ

361, *Pyralis farinalis*, venation; **362**, *Hypsopygia costalis*, venation of fore wing; **363**, *Aglossa pinguinalis* (Europe), venation; **364**, *Omphalocera dentosa*, venation and costal fold of male; **365**, *Aglossa cuprealis*, side view of head; **366**, *Cledeobia angustalis* (Europe), seta map of larva.

and **2d A**; **3d A** usually obsolete, becoming coincident with **2d A** in Hypsopygia (fig. 362). Hind wing without a fringe on base on **Cu**; **Sc** and **R** parallel, sometimes no closer beyond the cell than along it.

Larva essentially as in the Phycitinæ (fig. 366); pupa with a dorsal furrow etween ninth and tenth segments of abdomen, with crenulate margin; thoracic piracles slit-like and inconspicuous; end of abdomen with a transverse row of six r eight hooked setæ, without a specialized cremaster.

Key to the genera

1. Palpi upturned.
   2. Tongue very weak (about as long as eye or shorter).....57. **Aglossa.**
   2. Tongue well developed.
      3. R_3 and R_4 stalked farthest.....56. **Pyralis.**
      3. R_4 and R_5 stalked farthest.....58. **Hysopygia.**
1. Palpi obliquely upturned, with porrect third joint.....59. **Herculia.**
1. Palpi long, porrect, beaklike.....60. **Omphalocera.**

56. *PYRALIS* Linnæus

Tongue strong, scaled at base; palpi typically upturned to vertex; antennæ ypically with short ciliation (shorter than length of segments); fore wing ormal (fig. 361), M_2 and M_3 stalked; hind wing with M_2 and M_3 stalked; Sc and R ypically very closely parallel.

The second group is transitional to Aglossa.

Key to the species of Pyralis and Aglossa

1. Fore wing evenly colored, with white ante- and postmedial lines only. P. 1. *farinalis.*
1. Fore wing more or less mottled; no pure white; usually with discal spots.
   2. With a blackish discal spot, and usually costal spots at base and before apex.
      3. Basal blackish spot broad, usually reaching fold; subapical spot strong, dorsal two-thirds of wing contrasting, pale.....P. 2. *costiferalis.*
      3. Basal blackish spot usually a mere bar along costa, the apical spot tending to obsolescence; lines normally completely defined with dark; discal patch usually prominent.....P. 3. *disciferalis.*
   2. Ground dark with paler markings; discal spot pale when distinct.
      3. Ground pinkish coppery; antemedial tooth on fold strong, and usually filled with blackish; reniform usually a broad, pale, horizontal ellipse, strongly contrasting; tongue as long as eye.....A. 1. *cuprina.*
      3. Usually without red tint; blackish, with confused luteous markings only; the reniform and tooth of antemedial line not especially prominent; tongue very weak, not coiled.....A. 2. *cuprealis.*

1. P. farinalis Linnæus. Brown, somewhat olivaceous when fresh; median area uler, twice as wide as basal and terminal areas, the latter shaded with gray. ines white, defined, the antemedial strongly excurved; postmedial concave on pper two-fifths and in the fold; curved far out between. Terminal line pale; inge grayer. Hind wing with obscure antemedial, and fine, clear postmedial, ies on a ground shading from white to fuscous gray. 15–25 mm. (**H 47**:53.)

Larva injurious to meal etc. Dirty white, with a dark brown head; hooks on olegs biordinal, the shorter ones a quarter as long as the longer ones; prothorax ith posterior setæ on cervical shield approximately in a vertical line, but with e uppermost well in front of the others (nearer to them than to the anterior ries); front extending halfway, and adfrontals three-fourths way to vertex nlike Plodia); the three ventral ocelli in a right triangle.

Common and generally distributed. New York: Generally distributed and not re.

2. **P. costiferalis** Walker. Clay color, shaded and dusted with dull rose; with contrasting blackish base (above fold), patch on cell, and subapical costal patch; postmedial line excurved and serrate, diffuse, clay color; often defined on inner side with a blackish shade. Antemedial line similar, zigzag, or obscure. Hind wing pale, with a faint darker postmedial and rarely a subterminal line. 15–24 mm.

July to August.

In this and the next species, the antennal ciliations are longer than the segments, the tongue is very weak and half as long as the thorax, and **Sc** and **R** are farther apart in the hind wing. These species approach Aglossa.

July.

Ontario to Pennsylvania. New York: Saranac Inn, Ithaca, Big Indian Valley, Albany.

3. **P. disciferalis** Dyar. Shining dull rose, much darker than *P. costiferalis*. Costa barred with black on basal two-thirds, heavily toward base. Lines broad, pale, diffuse, heavily edged toward median area with blackish; the antemedial line zigzag and the postmedial excurved opposite the cell and concave toward the costa and in the fold. Hind wing much as in *P. costiferalis*, but darker, with a pinker costa. 15 mm.

July.

Maryland to Missouri. New York: Ithaca.

57. *AGLOSSA* Latreille

(Grease moths)

Similar to Pyralis, and only differing from the latter group of Pyralis in the weaker tongue (fig. 365). Antennal ciliation longer than the segments, fasciculate; tongue shorter than eye; M_2 and M_3 sometimes approximate only (fig. 363), but stalked in our species; **Sc** and **R** well separated beyond cell in hind wing; scaling shining, greasy looking.

1. **A. cuprina** Zeller. Tongue coiled and as long as eye. Clay color, heavily shaded with dull rose; the median area, and frequently the base and outer margin shaded with dark gray. Antemedial line zigzag and postmedial line strongly dentate, both edged with blackish toward the median area; tooth on antemedial line on fold often strongly contrasting, filled with a blackish patch, and cappe with a blackish arrow-head mark. Reniform horizontally oval, often with a diffuse black spot beyond it. Hind wing luteous, nearly immaculate. 18–23 mm.

June to September.

Generally distributed. New York: Ithaca, Rhinebeck.

2. **A. cuprealis** Hübner. Tongue reduced to two scaly lobes; fore wings dark luteous gray, marked with luteous, with little or no pinkish shading; lines as in *A. cuprina*; the antemedial, on the average, less deeply dentate, not defined with darker; reniform irregularly invaded by the dark ground, or obsolete. 18 mm.

Caterpillar gray, with brown head; a scavenger.

General; also in Europe. New York: Mt. Marcy (Hill), Ithaca, Poughkeepsie (New York State Collection), New Windsor (Morton), Brooklyn.

58. *HYPSOPYGIA* Hübner

(*Pyralis*, in part)

Like the typical group of Pyralis, except for the longer stalking of R_4 and R (fig. 362); **3d A** preserved, running into **2d A.** Caterpillar as in *Pyralis farinalis*.

1. **H. costalis** Fabricius (Clover-hay worm). Light dull rose; fringe very broad and pale yellow; lines rather fine, pale yellow, enlarged into large patches on costa of fore wing. 13–18 mm.

Very common, and generally distributed, sometimes injurious to stored hay. May to September.

New York: Ogdensburg, Lewiston, Sherwood (Cayuga County), Ithaca, Big Indian Valley, Onteora Mountain, vicinity of Albany, Rhinebeck, North Hillsdale and New Windsor.

Variety **hyllalis** Walker has the ground pale yellowish, the lines almost lost.

59. *HERCULIA*

(*Pyralis*, in part)

Similar to typical Pyralis, except as noted in the key; M_2 and M_3 free; **3d A** preserved.

Key to the species

Outer line finely dentate, dark, far out.....1. *intermedialis.*
Outer line even, nearly straight, often obscure.
Pinkish to violet-gray.....2. *olinalis.*
Clay-color.....3. *thymetusalis.*

1. **H. intermedialis** Walker. Wings narrower, suggesting Aglossa. Dull red-brown; terminal space distinctly redder and paler. Base pale; antemedial line strongly irregular, toothed far out on **Cu**, and less on **A**; pale followed with black; postmedial four-fifths way out, black, offset in to costa, and followed by a distinct pale patch; below, narrowly pale shaded. Hind wing paler, grayer, with the faint darker inner and outer line widely separated, and the outer nearly even. 22 mm. (*cohortalis* Grote.)

June and July.

Generally distributed. New York: Mt. Marcy, Fentons (Lewis County), vicinity of Buffalo, Ithaca, Hastings, New Windsor, Katonah.

2. **H. olinalis** Guenée. Dark gray with more or less violet tinge, and pinkish fringe, tipped with yellow; marked like *H. costalis*, but the lines straighter, and often obscure below the costa. Outer line on hind wing hardly beyond middle of wing. The ground sometimes much paler, rose pink (*himonialis* of authors, but not of Zeller, who had the typical form). 22 mm. (**H 47**:46; **48**:13.)

June and July.

New York: Lancaster, Peru, Ithaca, Big Indian Valley, Schenectady, New Windsor, New York City; Clove Valley, Staten Island.

Variety **infimbrialis** Dyar is ochreous with only a slight pinkish tinge, almost as light as *H. thymetusalis*. It occurr in southern Massachusetts, and is probably somewhat general in distribution.

3. **H. thymetusalis** Walker. Similar to *H. olinalis*; pale luteous, dusted and shaded with dull light gray, emphasizing the luteous lines on the side toward the median area, where there are distinct gray lines. Lines slightly dentate; antemedial excurved, broad; postmedial sometimes shortly interrupted, starting from a triangular costal patch. Hind wing paler, the lines close together; antemedial slightly irregular, and postmedial excurved. 22 mm.

Perhaps a variety of *H. olinalis*, with which it seems to intergrade.

A northern species, ranging south to the Adirondacks.

New York: Saranac Inn, Mt. Marcy, Fentons (Lewis County), Albany, New Windsor.

60. *OMPHALOCERA* Lederer

Palpi beaklike, clavate, the second joint long, straight and blade-like, the third long and porrect, sharply marked off. Antennæ simple, with scape long and nodified. Abdomen tufted dorsally. Fore wings triangular (fig. 364), moderate,

broad at base. R_3, R_4, and R_5 forking at nearly the same point; M_2 and M_3 free and well separated in both wings. Moths large and Noctuid-like in appearance.

Caterpillar exactly as in the Phycitinæ.

An aberrant genus, perhaps nearer to the Epipaschiinæ and lower Phycids than to the true Pyralinæ.

1. **O. cariosa** Lederer. Dull dark red-brown; base paler, and median area usually darker, or even blackish; usually concolorous to the inner margin; bounded by a rather evenly excurved antemedial line, whose upper part is oblique outward, and by a sinuous postmedial. Terminal space practically even, without the streaks and wedges of *O. dentosa*. Hind wing darker and more fuscous. 30 mm.

Larva a borer in fruit of papaw; blackish, with a broad red band on dorsum, and a lateral red band, separated by an equally wide black subdorsal area from the dorsal; red bands mottled with brown; tubercles white.

District of Columbia, southern Illinois, and southward.

2. **O. dentosa** Grote. Clay color, dusted and streaked outwardly with dark red-brown; a large, nearly square, dark-brown patch on middle of costa, extending halfway across the wing, shaded with black, and running out into teeth on the veins. Ordinary lines obscure, bordering the patch. Hind wing blackish, redder at margin. 35–40 mm.

June. Caterpillar black, dotted with white; without red bands; on barberry.

Southern Connecticut to Ohio, Iowa, and south.

Subfamily ANCYLOLOMIINÆ

Similar to the Crambinæ. Fore wing very frequently notched at the middle, and twisted in the resting position. Hind wing (fig. 367) in female with a simple frenulum; cell closed by a weak but distinct, middle discocellular vein; M_1 more or less weakened; widely separate from R at origin. Basal portion of Sc and R also widely separated in some cases.

This is a primitive type, related to the common stem of the Crambinæ and Phycitinæ. There are only a few forms in all, the majority in the Old World. The early stages are but little known.

61. *PRIONAPTERYX* Stephens

Front slightly conical, ocelli absent; male antennæ serrate; palpi about twice as long as head; tongue well developed. Fore wing with apex rectangular, abruptly offset inward at middle of outer margin, between M_2 and M_3, and crumpled at that point in the resting position. R_1 becoming coincident with Sc in our species. R_5 connate or short-stalked with M_1 in our species, but completely fused with it in the western *P. achatina*; M_2 and M_3 short stalked. Hind wing with Sc and R moderately anastomosing; the upper discocellular erect, middle discocellular complete, but rather weak, and oblique outward, but not strongly angulate, M_2 and M_3 fused in our species.

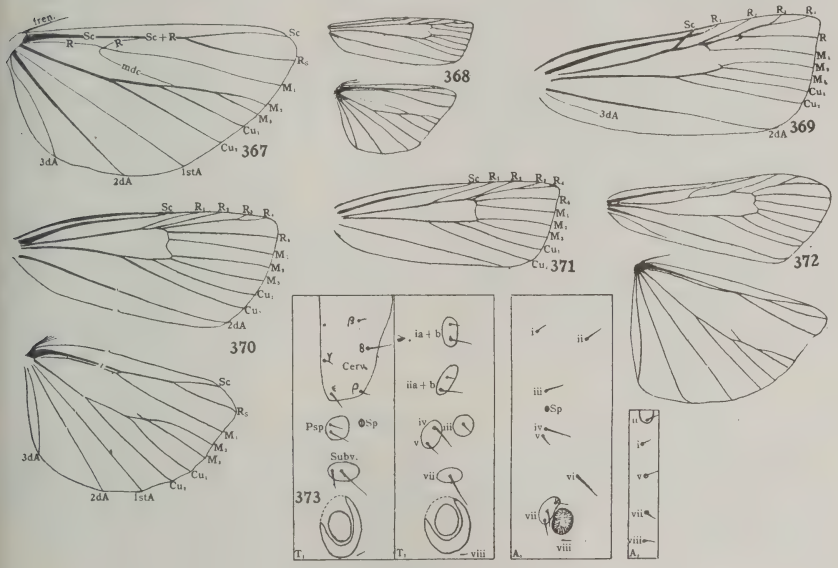
1. **P. nebulifera** Stephens. White, base blackish, costa shaded with fuscous; median area blackish, crossed by the zigzag white median line; subterminal line fine, white, defined on outer side with a fine dark line, and on inner with a blackish shade, with a tooth opposite cell; waved and concave below. Apex white; with a blackish ray running to the tooth of the outer margin, and with a black bar below it. Terminal line fuscous, and fringe pale, except on the tooth. Hind wing pale gray. 25 mm.

May to August; October.

The larva lives on the ground and forms a tunnel of sand and silk extending

up the stem of its food-plants to near where it feeds. It may be found on various sand-barren Ericaceæ.

Massachusetts to Texas, along the Coast. New York: Karner, Yaphank.



FIGS. 367–373. ANCYLOLOMIINÆ AND CRAMBINÆ

367, *Eufernaldia cadarella* (Ancylolomiinæ), venation of hind wing (Western States); **368**, *Crambus girardellus*, venation; **369**, *C. luteolellus*, venation of fore wing; **370**, *Argyria nivalis*, venation; **371**, *Platytes multilineatella*, venation of fore wing; **372**, *Ommatopteryx ocelleus* (Texas), venation; **373**, *Crambus* species, seta map of larva

Mesolia incertella Zincken reaches north to North Carolina. It has the same notched wing and a rather similar pattern; but a more conical front, and the subcostal cell of the hind wing nearly as wide as the discal — M_1 arising opposite the tip of the base of **R**, so that the upper discocellular is almost obliterated, but well separated from the stalk of **Sc+R**.

Subfamily **CRAMBINÆ**

Antennæ simple or pectinate, without modification at base; their sockets separated from the eyes by a band of scales. Ocelli most often present. Tongue variable; labial palpi beaklike, porrect; maxillary palpi large and triangularly dilated with scales. Tibiæ with all spurs. Fore wing (figs. 368 to 372) narrow, except in Argyria; with short outer margin; usually with all veins preserved; R_1 often anastomosing with **Sc**, R_3 and R_4 stalked; and R_2 and R_5 almost always stalked with them; **1st A** completely lost, the distance between **2d A** and Cu_2 at the margin being hardly wider than between any two veins. **3d A** free, weak. One or two radials or one median rarely lost. Hind wing ample, much folded;

Sc and R strongly anastomosing beyond the cell; female frenulum multiple, cel open, M_2 most often stalked, sometimes lost; a heavy fringe of simple bristle along base of Cu. Wings always smooth-scaled. Larvæ and pupæ of two radi cally different types, as described under Crambus and Diatræa.

The subfamily is fairly homogeneous.

Key to the genera

1. Fore wing with all radials preserved; R_1 sometimes very short and becom ing coincident with Sc.
   2. R_{2-4} stalked.....64. **Eoreuma**
   2. R_{3-5} stalked.
      3. Male antennæ uni- or bipectinate.....68. **Thaumatopsis**
      3. Male antennæ laminate, simple.....69. **Crambus**
   2. R_3 and R_4 only stalked.
      3. R_1 becoming coincident, or anastomosing, or connected by a crossvei with Sc.
         4. Palpi twice as long as head; front more or less conical....66. **Argyria**
         4. Palpi much longer.
            5. Ocelli present .....67. **Haimbachia**
            5. Ocelli absent .....62. **Diatræa**
      3. R_1 free.
         4. Ocelli absent. .....62. **Diatræa**
         4. Ocelli present.
            5. Front conical.....63. **Chilo**
            5. Front rounded.
               6. Palpus projecting its length beyond head.....66. **Argyria**
               6. Palpus projecting twice its length beyond head.....65. **Platytes**
1. Fore wing with two radials and a median lost.....70. **Raphiptera**

62. *DIATRÆA* Guilding

Palpi beaklike, extending two or three times the length of the head; antenna nearly simple, ocelli absent. Front usually conical. Body normally rather stout Fore wing moderately broad; R_1 typically becoming coincident with Sc; R_2 and R stalked; the rest free. Hind wing somewhat broader, with Sc and R rathe strongly anastomosed; subcostal cell narrow, normal; M_1 from upper angle o discal cell, and M_2 and M_3 connate.

Caterpillars, so far as known, borers in Gramineæ, and most commonly in wet places, slender, with strong tubercles; prolegs with an ellipse of triordinal hooks; vii *with two setæ* on *meso- and metathoraæ*, as in the Galleriinæ; setæ iv and v of abdomen obliquely placed, i and iii of ninth segment of abdomen approximate and ii of eighth and ninth segments forming single dorsal plates. Pupa usually cylindrical, truncate at anterior end; tongue short.

The first group is ancestral to both Chilo and Diatræa, and the species have been variously treated in the past.

Key to the species

1. Wings narrower; fold with alternating pale and dark shades.
   2. Hind wing white.....2. *forbesellus.*
   2. Hind wing clay-color or brown.....1. *comptulalis.*
1. Wings broader; fold evenly colored or streaked longitudinally.
   2. Fore wing mouse gray, with traces of postmedial dots or immaculate.
      3. *idalis.*

2. Fore wing yellow or brown.
3. Fore wing with a terminal dark line.....4. *alleni.*
3. Fore wing with dark terminal dots.....5. *zeacolella.*

I. Sc *and* R_1 *merely approximate.*

1. **D comptulalis** Hulst. Male dull brown, with grayer margin; a diffuse pale crenate and broken antemedial line; a finely dentate postmedial line roughly parallel to outer margin, toothed inward on A, and running in to costa, and a pale discal spot. Hind wing fuscous. Female light clay color, shaded lightly with brownish, leaving the whole cell pale, but with dark patches in the base and middle of the fold, and near the middle of the inner margin. Discal dot dark. A diffuse pale subterminal line, preceded by a well-marked dark band, defined on the outer side only. A slight, dark terminal shade. Hind wing slightly paler, with a corresponding terminal shade. 25 mm. (*Chilo* auct.)

Michigan to Missouri and west. New York: Ithaca.

2. **D. forbesellus** Fernald. Similar to *D. comptulalis.* Fore wing with more or less white scaling on disc, setting off the black discal dot; a streak of white scales in fold, interrupted by black bars near base and middle of fold; subterminal markings and terminal dots obscure. Hind wing white, in the male light fuscous apically, and with a distinct dark terminal line; in the female almost immaculate. Fore wings in some specimens much paler, light ochre yellow. 23–38 mm. (*Chilo* auct.)

Larva a borer in Scirpus.

Illinois; Missouri; New York: Buffalo.

3. **D. idalis** Fernald. Fore wing gray, obscurely or not striate, with traces of markings or none; hind wing white in female, pale gray in male. 25–34 mm.

New Jersey; Georgia.

4. **D. alleni** Fernald. Clay-color to brown, finely dark-streaked on and between the veins, the venular streaks even in width. A distinct discal dot. Terminal line obsolescent, but not breaking into dots. Inner margin sometimes contrastingly pale. Hind wing fuscous outwardly. 30 mm.

Maine. New York: Newport, Big Indian Valley.

II. Sc *and* R_1 *anastomosing.*

5. **D. zeacolella** Dyar. Clay color, finely streaked with dark on and between the veins; the venular streaks enlarging to form a very oblique series of postmedial dashes, and a subterminal series which is very oblique below; a dot at lower angle of cell, and slight terminal dots in interspaces; slight dark shades in upper part of cell, below cell, and extending obliquely to apex. Female with markings nearly lost. Hind wing white. 25–30 mm. (*saccharalis* auct., not Fabricius.)

Larva a borer in corn (not normally in cane); sometimes injurious.

Virginia and south.

63. *CHILO* Zincken

Similar to Diatræa. Ocelli prominent, front always conical, R_1 closely approximate to Sc for a distance, but free. Larvæ borers in water plants.

1. **C. plejadellus** Zincken. Whitish yellow; fringe, a broken line before it, a short, irregular, oblique median band, and scattered scales on disc, all lead-colored or silvery; black terminal dots. Hind wing white. 22–32 mm.

July.

Larva a borer in stems of rice, and presumably other swamp grasses; yellowish white, head dark brown, cervical shield light brown, body with four vague purplish stripes. Pupa with conical front.

New York to Wisconsin and Georgia. New York: Ithaca.

64. *EOREUMA* Ely

(*Chilo*, in part)

Similar to Diatræa and Chilo. Ocelli present; palpi as long as head and thorax, tongue weak. R_2 stalked with R_{3+4}, instead of approximate; front only slightly rounded out.

1. **E. densella** Zeller. Yellowish, dusted with brown, *veins white*, and with clearer yellow line halfway between the veins, alternating with brown lines; a strong black discal dot; black terminal dots and dark streaks opposite the cell and in the fold. Hind wing nearly white. 15–18 mm.

June and July; September.

Connecticut to Florida, Illinois, and Texas.

65. *PLATYTES* Guenée

(*Chilo*, in part)

Similar to Argyria; fore wing longitudinally marked, and typically narrower (fig. 371), palpus as a long as head and thorax. M_2 and M_3 of hind wing sometimes approximate (varying in our species). The only known larva in moss.

1. **P. panalope** Dyar. R_2 sometimes partly fused with the stem of R_3 and R_4 Cream color, with contrasting fuscous streaks. Outer side of palpi fuscous; fore wing with fine *dark streaks on veins* and heavy ones on interspaces, leaving white lines in the middle of the cell and on the fold. Discal dot black in a white ring. Terminal dots black. Hind wing nearly white. 12–15 mm. (*multilineatella* auct., not Hulst; *densellus* Fernald, not Zeller, at least in part).

Early stages unknown. Moth in June.

Southern States; Connecticut.

2. **P. vobisne** Dyar. Silvery white, with several dark brown lines, those in basal part of wing nearly longitudinal, and two zigzag postmedial and subterminal ones; a dark terminal area, and some dark postmedial shading. Hind wing blackish; fringe white with a dark line. 13 mm.

June; August.

Connecticut; South Dakota.

66. *ARGYRIA* Hübner

(*Platytes*, in part)

Ocelli present. R_1 normally straight, and parallel to Sc and R_2 (fig. 370), R_3 and R_4 only, stalked; M_2 and M_3 separate. Fore wing twice as long as wide, with moderate, somewhat excurved outer margin. Hind wing but little broader, with Sc and R strongly fused; M_2 and M_3 more or less stalked, often strongly. Front normally nearly flat. Palpi variable, normally projecting beyond head for a distance about equal to its length, rarely, nearly twice its length. Larva unknown, probably much like those of Crambus.

The tiny subtropical species *C. lacteella*, has been reported from Saranac Inn.

Key to the species

1. Fore wing with a yellow median fascia.
   2. Inner margin yellow on outer half ..... 3. *auratella*.
   2. Inner margin white on outer half ..... 4. *critica*.
1. No yellow fascia.
   2. Inner margin finely edged with yellow ..... 2. *argentana*.
   2. Inner margin white.
      3. Head white ..... 1. *nivalis*.
      3. Head and palpi deep yellow ..... *rileyella*.

I. *Front nearly flat, rounded; palpi as long as head; tongue stronger;* R_1 *free.*

1. **A. nivalis** Drury. Silver white. Palpi yellow on outer side, except on upper edge, sides of occiput yellow; a longitudinal stripe on thorax. Base of costal edge brown, terminal line black; fringe yellow at base, with whitish tips. A black dot at middle of inner margin, rarely lost. 20 mm.

Very common in grass land in June and July.

Generally distributed. New York: Newcomb, North Creek, Newport, Locust Lake, Lewiston, Lancaster, Ithaca, Big Indian Valley, Utica, Schenectady, Little Falls, Albany, Rhinebeck, New Windsor, Katonah, New York City.

2. **A. argentana** Martyn. Silver white; head, palpi, scape, and pedicel wholly brownish yellow; antennæ otherwise gray. Thorax with a yellow central stripe, fore wing with costal edge narrowly yellow, inner edge a little more broadly so, especially at middle; terminal line black, followed by a fringe shading from brown at base to pale yellow at apex. Hind wing straw color. 20 mm.

July.

Southern New Jersey; Pennsylvania; and south.

A. rileyella Dyar ranges north to North Carolina. It has a faint, slightly waved, dark postmedial line.

II. *Front distinctly conical; palpi twice as long; tongue weaker;* R_1 *anastomosing with* Sc.

3. **A. auratella** Clemens. Silver white; head and palpi white above, golden yellow on sides; thorax yellow, with white tegulæ, except the shoulders, which are yellow. Fore wing with a broad yellow median fascia, widening to inner margin, and fringe yellow, connected to the median fascia by a fine yellow line along outer half of inner margin; terminal dots black. 18 mm.

July.

Maine to California and south. New York: Ithaca, Albany, Rhinebeck, Katonah.

The southern race, **pulchella** Walker, is much smaller.

4. **A. critica** Forbes. Similar to *A. auratella;* front much less prominent (one-fourth width of eye in side view); fore wing with the median band not widening toward the inner margin, which is white between the median and the yellow terminal band. 18 mm.

July. (April, in Florida.)

Trenton, Ontario, and New Jersey, to Florida. New York: Utica, Ithaca.

67. *HAIMBACHIA* Dyar

(*Crambus,* in part)

Similar to Crambus. **R** anastomosing with **Sc**, R_2 and R_5 free, Cu_2 widely separated from Cu_1. Hind wing with M_2 and M_3 connate or very shortly stalked; **Sc** and **R** stalked almost to apex.

1. **H. placidella** Haimbach. Front rounded. Cream white, dusted with blackish out to the subterminal line; a darker pale brown medial shade, angulate on the cell, and a fine, sinuous, double subterminal line reaching almost out to the margin, filled with a slightly paler cream white. Terminal line continuous above, dots below; fringe lead colored. 16 mm.

July.

Northern New Jersey.

A second species of this genus ranges from New Jersey to Florida; it is closely similar to the Texan *H. squamulellus* Zeller, with a largely white fringe, and with yellow bars in the terminal space, but has a conical front. It appears to be undescribed.

68. *THAUMATOPSIS*

(*Propexus* Grote; *Crambus*, in part)

Closely related to the *mutabilis* group of Crambus, but with antennæ of male pectinate, or at least with slender laminations on the lower side twice as long as the segments. Fore wing normally with a slender longitudinal white streak on **Cu**, and sometimes on its branches toward margin, unlike all our species of Crambus. R_1 free.

T. repanda is reported from Saranac Inn and Newport, doubtless in error.

Key to the species

1. A contrasting white streak on **Cu**, the wing more or less darkened above it.
   2. Fore wing dark brown ..... 5. *dæckella.*
   2. Fore wing clay color.
      3. A defined black streak running obliquely to apex ..... 4. *fernaldella.*
      3. No such streak ..... 1. *pexella.*
1. No white.
   2. Mouse gray ..... 2. *gibsonella.*
   2. Yellow ..... 3. *edonis.*

* *Male antennæ bipectinate.*

1. **T. pexella** Zeller. Dull clay color, shaded below and outwardly, and somewhat striate with gray. A fine, somewhat sinuous white streak along lower side of cell, to end, fading out at base and rarely obsolete, with a dark, sometimes partly black, shade below it at base, and above at middle; an irregular series of oblique shades from opposite cell to inner margin, continued by a vague shade to apex. Terminal dots fine, dark. Hind wing nearly concolorous. 30 mm.

New Jersey; Connecticut; Illinois, and west. New York: New Windsor (Morton).

2. **T. gibsonella** Kearfott. Powdery mouse gray, strongly yellowish toward costa and base, with slightly paler **Cu**, and with traces of the dark shading of the last species. Subterminal markings obsolete, terminal dots minute or lost. Traces of an oblique median shade at inner margin. Hind wing nearly concolorous, with paler base. Female rather narrower-winged, with much paler and slightly yellower fore wing. 26–33 mm.

September.

Ontario.

3. **T. edonis** Grote. Closely similar to *T. gibsonella* but light ochreous yellow (when fresh, strongly pinkish). 35 mm.

Nantucket, Massachusetts; North Carolina; Kansas.

** *Male antennæ unipectinate.*

4. **T. fernaldella** Kearfott. Similar to *T. pexella*. Brighter yellowish, with obsolete subterminal markings; the black streak above the white line on **Cu** extending to the subterminal region and separated by a narrow longitudinal pale line from a fine curved oblique streak that runs to the apex. Black streak defined below, and pale edged below outwardly. 25 mm.

A western species reported doubtfully from Anglesea, New Jersey, and from Florida.

5. **T. dæckella** Kearfott. Fore wing rather dark brown, hind wing blackish gray; a longitudinal whitish streak on **Cu**, fading out near end of cell. 22 mm. (*Crambus haytiellus* Hart, not Zincken.)

Lucaston, New Jersey; Havana, Illinois.

69. *CRAMBUS* Fabricius

Tongue moderate; palpi projecting as far as length of head and thorax; male antennæ simple, laminate below, the laminations usually in contact; rarely more slender (*mutabilis*, etc.), but always more than half as wide as the length of a segment. Front nearly flat. Ocelli present. Fore wing (figs. 368, 369) narrow (normally about two and one-half times as long as wide), R_1 free or anastomosing with **Sc**; R_2 free; R_5 stalked, in our species shortly, with R_{3+4}; M_2 and M_3 free or short-stalked. Hind wing much broader, with **Sc** and **R** fused about three-fourths way to apex. M_1 from upper angle of cell, M_2 and M_3 almost always stalked.

Caterpillar (fig. 373) usually with good-sized tubercles, vii double on prothorax, single on meso- and metathorax; only a single lateral seta on ninth segment of abdomen; prolegs with an unbroken ellipse of the triordinal hooks.

The caterpillars live mostly in tubes of silk and earth, and feed on the roots and leaves of grass and other low plants. Several species have appeared from time to time in injurious numbers, and many are very common.

Pupa smooth, maxillæ reaching almost to tips of wings, but with the mid-legs meeting behind them; dorsum of thorax and abdomen not spined; sides of last segment with deep longitudinal furrows; labial palpi often largely exposed, normal. Caudal end usually truncate, with blunt angular spines; without a developed cremaster.

Key to the species

1. Ground color silver-white (including cell and costa, and outer and inner margins).
   2. Wholly silvery-white (or shining silver-gray) ..... 21. *perlellus*.
   2. With yellow below cell, and a black line on **Cu** ..... 12. *girardellus*.
   2. With black terminal, and usually subterminal, dots only .... 20. *turbatellus*.
   2. At least with a complete and regular subterminal line.
      3. Subterminal evenly excurved; seven terminal dots ..... 19. *elegans*.
      3. Terminal line above, and dots below.
         4. Subterminal line slightly curved opposite end of cell .. 16. *lyonsellus* var.
         4. Subterminal line sharply angulate.
            5. Expanse under 20 mm; no bright yellow ..... 17. *albellus*.
            5. Expanse over 20 mm.; a bright yellow streak .... 12. *girardellus* var.
1. Terminal space silvery; subterminal line erect, curved; median shade angulate. 19. *elegans*.
1. Inner margin, or terminal area, or both, dark; the ground not white.
   2. A fairly broad, white, more or less silvery stripe in cell from base, covering most of the width of the cell.
      3. White stripe practically reaching outer margin, but cut into trapezoidal patches by median and subterminal brown bands; the outermost patch almost terminal ..... 2. *myellus*.
      3. Postmedial silver trapezoidal patch absent, or not an even continuation with the silver stripe.
         4. Silver stripe continuing uninterrupted, and hardly narrowed to outer margin ..... 11. *unistriatellus*.
         4. Stripe at least constricted to half its width in subterminal region.
            5. Fore wing strongly falcate, with apex drawn out; an oval silver spot above tip of silver stripe ..... 18. *satrapellus*.
            5. Fore wing rectangular or subfalcate; no oval subapical spot.
               6. Terminal space crossed by fine black lines from subterminal line to margin; a strong costal silver streak, well separated from the subcostal one; ground cream color ..... 1. *laqueatellus*.

6. Terminal spots with black dots or short bars, longest in *C. quinquareatus*, which has only a single silver streak and dark brown ground.
7. A white costal streak, separated from the subcostal one by a fine brown line on R_3 ..... 3. *agitatellus*.
7. White streak broad, divided by a broad brown ray in upper part of cell ..... 6. *bidens* var.
7. White streak simple, leaving at least the costal edge brown.
8. A white or silver patch in middle of wing before the subterminal line, below or beyond the tip of the streak.
9. Apex forming an angle of 60°, the upper part of the outer margin at an angle to the lower; inner margin white, ground pale and streaked with lead color; brown terminal line and white in base of fringe ending abruptly at the angle of the outer margin; terminal dots marginal.
10. Inner margin pure silver white, with contrasting black edge, outwardly; expanse 28 mm.; lines on veins all lead-gray ..... 13. *dœckellus*.
10. Inner margin powdery and less contrasting, lines on veins a mixture of silver and blackish; expanse 22 mm. 14. *floridus*.
9. Apex more nearly a right angle, except in *C. exsiccatus;* outer margin even, the blackish terminal line and white base of fringe fading out gradually below.
10. Part of inner margin white, contrasting (sometimes only a small spot in *C. labradoriensis*, which is distinguishable by its very dark ground-color).
11. Ground dark brown, normally with a diffuse silver area on middle of inner margin, often cut in two by a blackish bar ..... 5. *labradoriensis*.
11. Ground bright yellow-brown, with a narrow silvery streak on inner margin ..... 7. *youngellus*.
10. Inner margin at most pale straw yellow, and in that case shading into the darker yellow ground.. 4. *alboclavellus*.
8. No such patch; ground continuous to subterminal line.
9. A contrasting pale spot in middle of terminal space; tooth on lower side of silver streak strong, and more than two-thirds way out ..... 6. *bidens*.
9. A pale spot below apical dash only, obscure in *C. lyonsellus;* tooth usually three-fifths way out, running into a slender line or obsolescent.
10. Silver patch only covering a little of costal region (above R), toward base.
11. Streak in cell as wide as costal brown area; terminal dots in the form of short bars, reaching the terminal line; grayish ..... 15. *hamellus*.
11. Streak in cell, beyond the tooth, twice as broad as the dark costal stripe; ground brown; terminal dots short and independent of the terminal line. 8. *præfectellus*.
10. Silver stripe broader, toward the base covering all but the costal edge, and covering R to end of cell.
11. Ground cream and yellow; silver streak lying along costa three-fifths way to apex ..... 16. *lyonsellus*.
11. Ground dark brown; streak gradually diverging from costa.

12. A silver stripe on inner margin; apex more acute. 10. *quinquareatus.*
12. Inner margin concolorous, brown; apex blunter. 9. *leachellus.*
2. A fine white line on Cu only.....(*Thaumatopsis* species).
2. Cell without a white or silver streak.
3. Terminal line continuous on costal half of wing, contrasting with the yellow terminal space, represented by three black dots below. 27. *hortuellus.*
3. Terminal line all broken into dots, or obscure.
4. Eyes less than one-half as wide as front; palpi hairy; a heavy oblique black median fascia.....33. *trichostomus.*
4. Eyes about as wide as front; palpi less hairy; a slight dark median fascia, or none.
5. Fringe bright golden bronze; six or seven black terminal dots.
6. Subterminal line even, silvery, and nearly parallel to outer margin; terminal space yellow.....23. *decorellus.*
6. Subterminal line diffuse, more or less irregular, strongly sinuate, and rapidly diverging from margin below; terminal space brown-dusted .....25. *ruricolellus.*
6. Subterminal line completely absent.....24. *vulgivagellus.*
5. Fringe dull, or dark lead-gray, rarely shining.
6. Subterminal line even, more or less metallic, and roughly parallel to outer margin; terminal space powdered with fuscous on whitish .....22. *teterrellus.*
6. Subterminal line irregular, diffuse, and much more oblique than outer margin, or obsolete.
7. A distinct blackish spot or oblique streak in fold below end of cell; a longitudinal pale shade through middle of wing.
8. Male antennæ with laminations narrow, separate; fore wing with six or seven terminal dots; pale shade whitish. 26. *mutabilis.*
8. Male antennæ with laminations in contact; fore wing with three or four terminal dots on dorsal half; pale shade ochre yellow .....28. *trisectus.*
7. Median shade but little darker than ground, or obsolete; no discolorous longitudinal shade through cell.
8. Three or four terminal dots on dorsal half of wing; ground pale gray .....29. *laciniellus.*
8. Terminal line very weak and continuous, or enlarged into slight dots on all the veins.
9. Ground yellow .....32. *luteolellus.*
9. Ground fuscous, sometimes heavily dusted with fuscous on a dirty white ground.....30. *caliginosellus,* 31. *zeellus.*

Thaumatopsis gibsonella will run to near *luteolellus*, but the subterminal line is obsolete, *edonis* may be distinguished by its large size (35 mm.), also.

I. *Palpi moderately hairy, eyes about as wide as front* (Crambus).
A. *Fore wing with* Sc *and* R_1 *separate, normally approximate* (fig. 368).

* *Fore wing with a silvery stripe.*
† *Fore wing normal in form.*

1. **C. laqueatellus** Clemens. Straw color, costal and cellular silver stripes rather widely separated; a large triangular costal subterminal streak. More or less silver on veins, edged with black; terminal space pale, with five fine

black lines across it. Terminal line black on costal half of wing, preceded with silver, subterminal line also silvery. 23 mm.

Common and generally distributed, in June. Larva on moss; refusing grass, at least when young. New York: common everywhere.

2. **C. myellus** Hübner. Chocolate brown, shading into ochre yellow at margins; three silver-white patches in middle of wing, separated by brown fasciæ, the first running to the middle of the wing, obliquely triangular, the second half as long and rather trapezoidal, the third a narrow subterminal bar. Terminal line obscure, continuous; fringe gray, cut with white opposite the cell. 22 mm. (*luctuellus* Fernald, not Herrich-Schæffer).

July. Caterpillar under moss; brown, with black head and cervical shield.

Labrador to Carbondale, Pennsylvania, and west to British Columbia. New York: Karner.

3. **C. agitatellus** Clemens. Fore wing broader than that of *C. laqueatellus*, of the same pale yellow, becoming darker along the markings, and nearly white on the inner margin. Silver streaks broader and separated only by the fine, often incomplete line along **R**; the longer streak less than three-fourths of the length of the wing. Middle of wing silver white from cell to outer margin, cut by the silver and yellow subterminal line. Apical marks as in *laqueatellus;* terminal line fine and black on costal third, replaced by five thick dots along outer margin below; base of fringe silver white toward costa, the rest silver gray. Hind wing cream white, lightly shaded with gray. 20 mm. (*saltuellus* Zeller.)

Generally distributed and common, especially northward; flying mostly in July. New York: North Elba, Summit of Mt. Marcy, Newcomb, North Creek, Rock City (Cattaraugus County), Ithaca, Trenton Falls, Schenectady, New Windsor, Crugers; Lynbrook, Long Island.

4. **C. alboclavellus** Zeller. Identical with *C. agitatellus* except for the lack of the brown line on **R**, probably a variety of it. Ground color usually a little darker, and sometimes a little shaded with dark brown; trapezoidal patch beyond the silver streak usually brighter silver and standing out more distinctly (*carolinellus* Haimbach).

July and August. Larva on grass.

Common and generally distributed. New York: Newport, Newcomb, Lewiston, Potter Swamp (Yates County), Ithaca, Big Indian Valley, Utica, Schenectady, New Windsor, Fort Montgomery, Katonah.

5. **C. labradoriensis** Christoph. Dark brown, diffusely shaded with whitish, especially opposite the cell, over M_2 to Cu_1, and in areas extending to the inner margin before and on the middle of the wing; a silver bar in the cell, broad outwardly, but hardly reaching beyond middle of wing, separated from the whitish area beyond by a broad zigzag median band, the tip of the silver streak forming two teeth, the lower of which is only a little smaller than the upper; costa broadly brown; subterminal line normally silvery, a little enlarged at costa. A triangle before and one beyond it at costa. A terminal line above, and dots below, preceded narrowly with white. Hind wing fuscous. 20 mm. (*luctuellus* auct., not Herrich-Schæffer.)

This species may prove to be a race of *C. luctiferellus*, of Europe, which has **Sc** and R_1 anastomosing. I have not examined the venation. *C. dissectus* Grote appears to be the same, both names applying to light forms.

New York (type of *dissectus*) and Mer Bleue, Ontario, to Oregon, and north.

6. **C. bidens** Zeller. Similar to *C. alboclavellus* and *C. agitatellus;* silver streak three-fifths length of wing, its tip bluntly angled, reaching costa, leaving only a fine brown costal edge, and strongly toothed below, at origin of Cu_2. Ground brownish ochre; no silver patch in middle of wing beyond cell; but middle of terminal space white; black terminal line extending below middle of wing; the dots somewhat elongate and distinctly farther from the margin than the terminal

line is. Sometimes with a broad brown ray in the silver streak. Hind wing white, or cream with a white fringe. 18 mm.

This species is usually found in peat-bogs.

Quebec to Massachusetts, New York, and northern New Jersey. New York: Niagara Falls.

7. **C. youngellus** Kearfott. Closely similar to *C. bidens*, but smaller; brown costal edge slightly wider, ground yellow and somewhat dusted with light brown; a silver postmedian patch and a silver stripe on inner margin; terminal line stopping above middle of wing, and dots only below; more or less silver along the veins. Apical markings as in the preceding group; the terminal line and white streak in the fringe not ending abruptly as in *C. floridus*. Subterminal line broader than in *C. alboclavellus*. 18 mm.

Mer Bleue, Ottawa, Ontario.

American records of *C. hamellus* appear to belong in part to this species.

8. **C. præfectellus** Zincken. Chocolate brown; inner margin hardly paler. Silver streak covering cell, and extending well beyond it, but not reaching the subterminal line, and separated from the costa by half its width; a slight silver streak above its apex, but the veins on the disc hardly, or not at all, marked with silver; subterminal line silvery, as usual; moderately bent opposite cell, but little widened at the costa. Terminal space brown, with silver triangles above and below an oblique apical dash; a few white scales in lower part of wing, but no spot. Terminal line brown, hardly darker; dots below oval, and set well back from margin. Fringe shining brown-gray, becoming white in its base, toward the apex. Hind wing cream white. 2 mm.

Two broods, flying mainly in June and August; common. New York. Common everywhere.

Generally distributed.

Hardly distinct from *C. leachellus*. In the Colorado race, **oslarellus** Haimbach, the hind wing is dark.

9. **C. leachellus** Zincken. Like *C. præfectellus*, but with the costal edge only very narrowly brown toward the base; apex normally slightly more acute; region beyond tip of silver streak distinctly yellow. Frequently larger; expanding up to 27 mm.

June and July.

Common and generally distributed, flying with *C. præfectellus*. New York: Wilmington, Saranac Lake, Newport, Ithaca, New York City, Yaphank.

This species is probably the true *hastiferellus* of Walker, rather than the following, which may be a southern race of it.

10. **C. quinquareatus** Zeller. Closely similar to *C. leachellus*, the light area beyond the tip of the silver stripe nearly white, and connecting it with the subapical silver triangle, which is a little larger than in *C. leachellus*. Apex a little more strongly pointed, but terminal line and white streak in fringe not ending abruptly; terminal dots replaced by slender bars nearly as long as those of *C. laqueatellus*, on a fuscous ground. No silver line above the tip of the streak in cell. (*extorralis* Hulst; *hastiferellus* auct., not Walker.)

Southern States, north to Pennsylvania; northern distribution uncertain on account of confusion with *C. leachellus* (*hastiferellus* Walker.)

11. **unistriatellus** Packard. Chocolate brown; a broad silver white stripe from base to costal half of outer margin, leaving a brown costal stripe which is extremely narrow at the base and apex, but reaches down to the cell between, and is widest at three-fourths way out. Terminal line and dots very weak; costal half of fringe white. 25 mm. (*exesus* Grote.)

Apparently rare.

Labrador to Pennsylvania; west to California. New York: Saranac Inn, North Creek, Newport, Trenton Falls, Schenectady.

12. **C. girardellus** Clemens. Silver white; a bright yellow stripe from base to postmedial region, below cell, in typical specimens widening and then fading out at outer end; defined with a black line above; a little yellow on base of costal edge; and sometimes beyond middle also, rarely forming an angulate fascia, bounded by fine black postmedial and subterminal lines; terminal line fine, black, preceded by black dots on dorsal half. 25 mm. (*nivihumellus* Walker.)

Common in June and July.

Generally distributed south to Pennsylvania and Ohio. New York: Saranac Inn, Newcomb, North Creek, Fentons (Lewis County), Batavia, Rock City (Cattaraugus County), Otto, Ithaca, Trenton Falls, Liberty, Big Indian Valley, Schenectady, Nassau, New Windsor, Katonah, New York City, Fort Montgomery.

13. **C. dæckellus** Haimbach. Near *C. floridus*, but much larger, deeper yellow-brown, the veins streaked with lead-gray only; the brown line between the silver cell and postmedial patch, twice as wide as a vein; terminal space more evenly yellowish in color, and narrower, even, than in *floridus;* inner margin, below A, pure white, though with diffuse upper boundary; the outer half of the inner edge narrowly blackish. Terminal markings as in *floridus*. 27–31 mm.

September.

New Jersey generally; perhaps elsewhere confused with *C. floridus*.

14. **C. floridus** Zeller. Closely similar to *C. alboclavellus* (and *agitatellus*); apex a little more acute, with a distinct inward angle opposite the cell, at which the black terminal line stops abruptly. Silver streak diverging gradually from costa, and acute, as in *leachellus*. Inner margin silver white, but not contrasting nor sharply defined; apex more contrastingly white. 22 mm.

June and July. Caterpillar on grass.

Atlantic States (apparently not common) to California. New York: Ithaca.

Very close to both *alboclavellus* and the European *C. pascuellus*, of which latter it is probably a race.

15. **C. hamellus** Thunberg. Fuscous; apex a little produced; silver stripe very narrow, being not wider than the brown costa, outwardly; terminal dots on dorsal half of wing a little elongate, followed by a fine terminal line. Hind wing grayish; inner margin not pale. 20 mm.

August.

Our form is very dark on the costa above the silver streak.

Kamouraska, Quebec; Maine; Mt. Wachusett, Massachusetts (Forbes); Europe. New York: Saranac Inn and Albany. (New York State Collection.)

16. **C. lyonsellus** Haimbach. Similar to *C. floridus;* apex squarish; silver streak almost touching the costa to beyond the middle, then abruptly leaving it, as in *C. bidens;* no distinct silver postmedial spot; subterminal line regularly curved, meeting the costa almost at right angles; terminal line not ending abruptly at middle of outer margin. Subterminal and terminal spaces typically filled with bright ochre. 21 mm.

Late June.

Ottawa, Ontario; New Jersey.

17. **C. albellus** Clemens. White, very rarely pale gray; outer margin somewhat shaded with pale yellow. Medial line dark brown, fine, strongly angled out on discal fold, forming an acute tooth, obsolete on dorsal half of wing, or represented by some black scales. Postmedial line indicated by a costal stria; subterminal line double, light brown, silver-filled, angled opposite the cell, where its outer line may touch the margin. Fringe silver gray, with a white base on the costal third, ending abruptly at the tooth of the subterminal lines. Hind wing gray. 15 mm.

June and July. Larva on grass.

Common in wet places.

New York: Trenton Falls, Rock City (Cattaraugus County), Ithaca, Big Indian Valley, Schenectady, Poughkeepsie, New Windsor.

†† Fore wing with long-drawn-out, falcate apex.

18. **C. satrapellus** Zincken. Silver streak broad, but widely separated from costa; ending in a sharp point seven-eighths way to outer margin, with a large oval silver spot above its tip, and with a slender spur from its lower side, running along Cu_2. Ground yellow, becoming brown along the veins and edges of the markings. Terminal space powdery fuscous, cut by short black streaks below; terminal line obsolete below; subterminal line lead gray, running across the apex, obsolete below; fringe white, brown-tipped on costal half. A white oblique streak running to the apex. Hind wing pale gray. 25–35 mm.

July.

Southern States, north to New Jersey; South America.

*** Fore wing without a silvery stripe.*

19. **C. elegans** Clemens. Ground white; more or less shaded with dull brown, always brown before the subterminal line, and more or less so along the costa toward the base, and on the outer margin; sometimes dominantly brown, but always with a large part of the terminal space white. A brown median oblique shade to beyond middle of costa, often forming the inner boundary of a brown area; and a blackish oblique shade running to the middle of the inner margin; the two sometimes connected by a brown line which forms a long tooth opposite the end of the cell, and is preceded by a white line. Subterminal line characteristic, white, followed by brown, nearly erect, but slightly excurved. Seven black terminal dots. 12–15 mm.

Larva on grass. Moth from July to September.

Common and generally distributed. New York: Wilmington, Speculator, Otto, Ithaca, Katonah, New Windsor, New York City, Staten Island.

This is a broad-winged primitive species of doubtful affinity, superficially very closely resembling *albellus*, but apparently not related. Sc and R_1 are closely approximate but not fused.

A form of **C. polingi** Kearfott has been taken a few times at Ithaca, New York, in July. It is grayer than *C. elegans*, with the double dark subterminal band markedly angled opposite the cell, and inwardly oblique to costa, filled with white at costa, but below more or less definitely dentate, and suffused; with the black crescent on the inner margin constricted on **A**; the terminal dots enlarged, and typically fusing into a line; and the labial palpi heavily banded with white. It was described from Arizona.

20. **C. turbatellus** Walker. Silver white; a black dot at lower angle of cell; one below cell beyond middle, and a subterminal series; a sinuous postmedial series, very often lost, and a terminal series of seven dots. All the dots except the terminal ones and the one below the cell frequently obsolete. 20–25 mm. (*bipunctellus* Zeller.)

July.

Canada to Pennsylvania and Illinois. New York: Otto, Rock City (Cattaraugus County), Ithaca, Big Indian Valley.

21. **C. perlellus** Scopoli, race **innotatellus** Walker. Silver white, without markings; the female often silver-gray; hind wing sometimes pale gray in the male also. 20 mm. (*sericinellus* Zeller, *inornatellus* Clemens.)

July and August. Larva on grass.

Northern States, south to northern Pennsylvania, Illinois, and California; commoner northward. New York: Wilmington, North Elba, Saranac Inn, Newcomb, Newport, Otto, Big Indian Valley, Onteora Mountain.

The typical form from Europe is darker.

22. **C. teterrellus** Zincken. Fuscous brown, strongly shaded with violet-gray between the veins; fresh specimens often dominantly violet-gray. Median line

brown, running across the end of the cell and bent at a right angle on the cell; irregular and black across the fold, where it usually forms a short tooth; subterminal line dark brown, followed by lead gray, and then again with brown toward the costa, somewhat excurved, bending away from the outer margin toward the costa. Terminal space powdery fuscous, each scale pale with a broad brown tip; seven black terminal dots; fringe shining lead-gray, without golden tint. 15–21 mm. (*camurellus* Clemens, *terrellus* Zeller.)

June and July. Larva on grass; yellowish or greenish white, with darker dorsal vessel; tubercles and setæ large; head rough, dull light brown; cervical shield darker, inconspicuous.

Common north to New York; rarer in Maine. "New York" (American Museum Natural History.)

23. **C. decorellus** Zincken. Clay color, broadly shaded with shining ash gray between the veins, much more conspicuously streaked in appearance than the last species. Median line brownish yellow, a little irregular and excurved, partly black in the fold; subterminal line brownish yellow, followed by lead gray; evenly excurved, very closely parallel to outer margin except at costa; the terminal space ochre yellow, often containing a gray streak toward the costa, but not powdery. Seven black terminal dots; fringe golden bronze. 19–27 mm. (*polyactinellus* Zeller, *goodellianus* Grote, *bonusculalis* Hulst.)

July and August.

Massachusetts to Georgia and Texas. New York: Ithaca and New Windsor.

24. **C. vulgivagellus** Clemens. Clay color, broadly striped with dull gray between the veins; no transverse markings; seven black terminal dots; fringe golden bronze. 20–39 mm. (usually 25 mm.).

Late August and September. Larva on various grasses and grains, brown with darker tubercles, and a deep brown cervical shield. Head black. Hibernation in the half-grown larva; cocoon spun in May; pupation in July.

Common and generally distributed. New York: Common and general.

25. **C. ruricolellus** Zeller. Clay color, shading into ochre at costa and outer margin; lightly dusted with deep brown, usually leaving the costa nearly clear; median and subterminal lines indicated by a gathering of the dusting; the median short, thick, oblique, in the middle of the disc, sometimes weakly continued to the costa and inner margin; the subterminal oblique, sinuous, nearest outer margin opposite the cell; veins toward the apex often streaked with pale gray and edged with the brown scaling. Seven terminal dots; fringe golden bronze. 20 mm.

Larva on grass and sorrel. Moth in August and September.

Common south to Pennsylvania and Missouri. New York: Ausable Lake, Wilmington, Saranac Inn, Honeoye Falls, Batavia, Hemlock Lake, Ithaca, Liberty, Big Indian Valley, and Onteora Mountain.

26. **C. mutabilis** Clemens. Male antennæ with narrow, well-separated laminations, almost appearing unipectinate. Fore wing dull ash gray, with whitish streak from base, through cell to costal half of outer margin; streaked outwardly with the ground color; and with scattered black scales. Median line usually reduced to a black patch in upper part of fold near end of cell, irregularly oblique when more distinct; subterminal line usually reduced to dots, nearly parallel to outer margin, and regularly dentate on the veins when distinct. Seven minute black terminal dots; fringe powdery fuscous, hardly shining. Hind wing light fuscous.

Larva on grass. Moth in August.

Common and generally distributed. New York: Peru, Newport, Lancaster, Otto, Rock City (Cattaraugus County), Ithaca, Big Indian Valley, New Windsor, New York City.

B. Fore wing with R_1 *anastomosing, or becoming coincident, with* Sc (fig. 369).

** Terminal line continuous above, replaced by black dots below.*

27. **C. hortuellus** Hübner, race **topiarius** Grote. Clay color, becoming clear yellow toward the outer margin; with dark fuscous, more or less shining stripes between the veins, leaving a clear yellow space before the subterminal line; two such stripes in the cell, and three oblique ones running down from the costa outwardly, the first nearly longitudinal and extending along the costa to the base; subterminal line silver gray, angled moderately opposite the cell, often edged with brown, and followed by a second silver streak at the costa; terminal line and dots contrasting on the yellow ground; fringe shining, somewhat bronzy. Hind wing gray, with a pale fringe as usual in the genus. 18 mm.

Very common in June and July. Larva on various low plants; sometimes injurious to cranberry. Larva dirty gray with light yellow-brown head, and with black clypeus and labrum; cervical shield inconspicuous.

Generally distributed. New York: Common and general.

*** Terminal line formed of dots or inconspicuous.*

28. **C. trisectus** Walker. Light grayish luteous, shaded with dull gray between veins, leaving fine pale streaks on the veins, and outwardly in the middle of the interspaces; costal region more or less streaked with yellowish, sometimes clear light ochre. Median and subterminal lines represented by blackish oblique shades across the middle of the wing; terminal dots weak, often obsolete; fringe fuscous, strongly cut with white between the veins. 28 mm. (*biliturellus* Zeller, *exsiccatus* Zeller, *interminellus* Walker.)

Larva on grass. Two broods, the moth flying in June and August.

Generally distributed and not rare. New York: Newport, Fentons (Lewis Co.), Newcomb, North Creek, Honeoye Falls, Batavia, Lewiston, Otto, Ithaca, Big Indian Valley, Little Falls, Schenectady, Nassau, Rhinebeck, New Windsor, and Lynbrook, Long Island.

Inornatellus Walker may be a pale or rubbed specimen of this species.

29. **C. laciniellus** Grote. Fore wing pale cinerous ochreous, especially on the costal and outer portion of the wing; a few scattered brown scales. Median and subterminal lines faint, of ochre scales, partly overlaid with brown; three terminal dots on dorsal part of wing; fringe evenly gray, pale at base. 27 mm.

Maine.

30. **C. caliginosellus** Clemens. Smoky brown or fuscous; somewhat powdery and showing traces of a luteous ground. Median and subterminal lines blackish, underlaid with yellow-brown, irregularly dentate, and roughly parallel; often broken and obscure, the median line sometimes obsolete; terminal line faint, widening into dots between the veins in some specimens. Fringe and hind wing concolorous. 13–25 mm.

Larva pinkish white, tinged with brown; with a dark brown or black head; sometimes injurious to young corn, girdling it and eating out the growing point; also on grass. Two broods, June to end of August.

Common and generally distributed. New York: Lancaster, Otto, Ithaca, Nassau, Greenwich, New Windsor.

31. **C. zeellus** Fernald. Closely similar to *C. caliginosellus*, of which it may be a pale variety; ground luteous, considerably overlaid with smoky brown; with the markings of *C. caliginosellus* in blackish brown. 18–24 mm.

Larva like *C. caliginosellus;* likewise injurious to corn.

Maine to West Virginia, Illinois, and Missouri. New York: Batavia, Ithaca, Big Indian Valley, Little Falls, Albany, Rhinebeck, Katonah, Staten Island.

32. **C. luteolellus** Clemens. Pale ochre yellow, marked with tawny brown; the markings exactly as in *caliginosellus*, but weaker, and often nearly obsolete. Fringe pale brown, not shining. Valves more slender than in *caliginosellus* and *zeellus*. 23 mm.

Common and generally distributed. New York: Peru, Newcomb, Ithaca, Little Falls, Katonah.

The variety **ulæ** Cockerell, from Colorado and Arizona, is much more contrasty, and has black terminal dots.

II. *Eyes half as wide as front, or slightly less; palpi very hairy; venation as in the first group.*

33. **C. trichostomus** Christoph. Powdery dull light gray; head and thorax blackish; a broad oblique blackish antemedial band from middle of costa to a third way out on inner margin, followed by a white shade; a similar, but usually narrower, subterminal band, roughly parallel to the outer margin, but sinuate below the costa, followed by a stronger white shade. Terminal line practically continuous, heavy, black; fringe gray, cut with white. Hind wing slightly browner. 20 mm.

Labrador.

70. *RAPHIPTERA* Hampson

(*Crambus*, in part)

Similar to Crambus; R_1 lost and R_3 and R_4 completely fused, also M_2 and M_3, leaving no stalked veins in the fore wing. Hind wing with M_2 and M_3 completely fused; fore wing strongly falcate.

1. **R. minimella** Robinson. Mouse gray; cell white, slightly silvery, the streak ending in a point five-sixths way to apex, with a white chevron over its apex, and a triangular patch running to tip of wing; costa shaded with luteous as far as the postmedial line; postmedial line oblique outward to opposite cell, then brown, nearly even and parallel to outer margin, across to the inner margin. Hind wing fuscous, sometimes pale at base. 12 mm.

Southern States and Illinois.

2. **R. argillaceellus** Packard. Similar, slightly larger; costal region not contrastingly pale, there being strong dark stripes both above and below **R**, the lower one noticeably narrowing the stria in the cell. 10–15 mm.

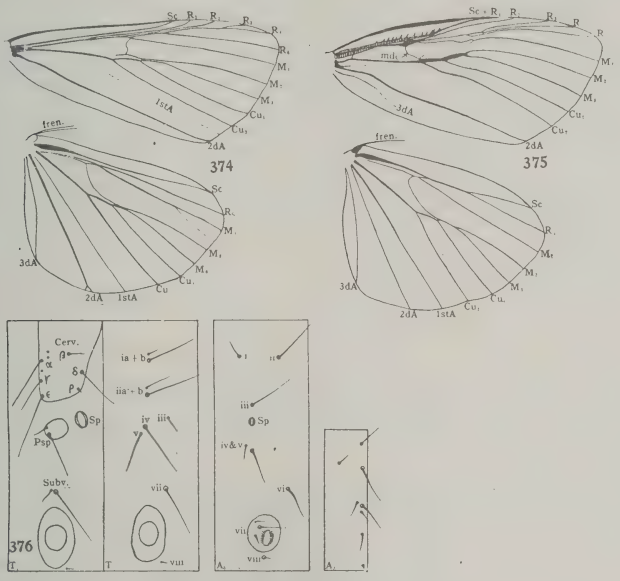
This is probably a northern race of *R. minimellus*.

Labrador, Mer Bleue; Ontario; Wisconsin; Connecticut. New York: McLean Bogs.

Subfamily **EPIPASCHIINÆ**

Antennal socket more or less completely surrounded by scales, in the type genus with a wide gap on the lower side of the circle, leaving the socket in contact with the eye, but more often with the antenna and eye wholly separated by a scaled area. Ocelli present; antennæ normally fasciculate in male, often with a long plume-like process on scape. Labial palpi large, upturned, in many males hollowed out, and enclosing the plume-like maxillary palpi. Maxillary palpi of females and of a few males normal, somewhat triangularly scaled; always well developed. Tongue developed. Fore wing with R_1 free, R_5 stalked with R_3 and R_4. Male often with fovea and distorted venation; **1st A** absent; **3d A** free and weak. Frenulum simple in both sexes. Hind wing with **Sc** and **R** approximate or anastomosing; M_1 from near upper angle of cell; cell distinctly

closed by a strongly curved vein, M_2 from lower angle or stalked; Cu with weak fringe or none.



FIGS. 374–376. EPIPASCHIINÆ

374, *Epipaschia superatalis*, venation; **375**, *Tetralopha asperatella*, venation, and sex characters of male; **376**, *T. militella* (?), seta map of larva

This is a small group, transitional between the Pyralidinæ and Phycitinæ. The larvæ (fig. 376) are normally leaf rollers much like those of the Phycitinæ; one Indian species, at least, is social.

Key to the genera

Sc and R of hind wing approximate (fig. 374).....71. Epipaschia.
Sc and R fused for a distance beyond end of cell (fig. 375).
Raised scale ridge extending up uninterrupted, across wing from just below costa almost to inner margin.....72. Oneida.
With separate raised tufts in cell and fold, and sometimes below A.
73. Tetralopha.

71. *EPIPASCHIA* Clemens

(*Macalla*, in part)

Male with fasciculate antennæ; process on first joint very long and heavily fringed with hair below, turned back over thorax; palpi not modified; fore wing (fig. 374) with R_2 and M_1 free, M_2 and M_3 closely approximate at base or stalked; hind wing with M_2 and M_3 closely approximate or stalked; M_2 when approxi-

mate appearing to be a continuation of the discocellular vein, as in many Phycitinæ.

1. **E. superatalis** Clemens. Clay color, often more or less dusted with gray and black; antemedial line dentate and broken, or reduced to dots; postmedial oblique above, triangular and sinuous below, black, subdentate and tending to break up into dots, followed by a narrow pale area; the outer margin largely or wholly dull red-brown to gray. Black terminal bars. Hind wing fuscous, somewhat paler at base. 20–25 mm.

Generally distributed. New York: New Windsor; Chappaqua, Long Island.

2. **E. zelleri** Grote. Base dull gray, ending in a broad, straight, erect, antemedial line, slightly dentate in female; postmedial line sinuous, meeting costa and inner margin at right angles; with a little whitish beyond it on costa. Median area whitish, more or less suffused with gray, especially in the female; a more or less distinct blackish discal bar. Terminal space concolorous with base. Hind wing gray. 23 mm.

July.

New Jersey to Florida and west.

72. *ONEIDA* Hulst

(*Tioga*, in part)

Similar to Tetralopha, except as noted in the generic key. The position of M_1, which has been used for the separation of Oneida from the Tetralopha group, is variable in both genera. The male maxillary palpi and wings are apparently not modified.

1. **O. lunulalis** Hulst. Bluish gray, rather pale before the scale ridge, which is of brown-tipped scales. Antemedial line far out, excurved, double, obscure. A small whitish tuft toward end of cell, and a pale brown raised discal bar. Postmedial concave on upper half of wing, contrasting, pale, followed by a series of blackish streaks on a brown patch, and preceded by a dark brown line; rest of the line very weak and nearly parallel to outer margin. A broken dark terminal line and a pale line in base of fringe, followed by a gray shade. Hind wing light fuscous. 22 mm.

June to August.

Massachusetts to Illinois; Canada. New York: Ithaca.

73. *TETRALOPHA* Zeller

(*Pococera*, in part; *Lanthaphe* Clemens; *Benta* Walker; *Ratona, Saluda, Loma, Wanda, Attacapa, Tioga* Hulst; etc.)

Scale ring about socket of antenna complete; male antenna fasciculate, with a more or less developed process on the scape; maxillary palpus of male plume-like, enclosed in a groove in labial palpus. Fore wing (fig. 375) with small separated antemedial tufts; venation unstable, but normally with R_2 stalked, M_1 free, M_2 and M_3 approximate or shortly stalked; male with a more or less hyaline area in the cell, with a large tuft of enlarged scales projecting down from costa on the under side and partly covering it. Hind wing with **Sc** and **R** fused beyond cell, M_2 and M_3 approximate, or normally stalked.

The species are almost hopelessly confused, and the analysis below may not be wholly correct.

Key to the species

1. Antemedial and subterminal spaces suffused with light reddish brown. ***5. baptisiella.***

1. Outer part without strong pale red suffusion.
   2. Thorax and base mostly white. ***6. humerella.***
   2. Head, collar, and base of wings suffused with pinkish. ***4. militella.***

2. Head, thorax, and base of wings powdery gray.
3. Thorax and base of wings brown; black scaling of wing with purple iridescence .....7. *robustella.*
3. Thorax and base paler luteous or gray; purple iridescence, when present, on the paler scales of outer part of wing.
4. Ante- and postmedial lines both more or less diffuse; the ground almost evenly powdery gray.....1. *asperatella.*
4. Postmedial line clean-cut, black, similar to the outer antemedial line which is followed by a whitish shade.....3. *melanogrammos.*
4. Postmedial line more diffuse, less contrasting than the outer antemedial, which is followed by a whitish shade.....2. *subcanalis.*

1. **T. asperatella** Clemens. Rather even powdery gray (black on white). Outer half of wing sometimes distinctly paler, especially in female; tufts small, well contrasted, black; antemedial line doubled, darker gray, outwardly oblique, interrupted in cell by the translucent area in male; postmedial irregularly sinuous, denticulate, followed by a paler shade, inconspicuous. Process on antennæ longer than scape; normal; plume variable, yellow or blackish. 20–25 mm.

Larva green, granulated with yellow; on oak, maple, elm, and beech. Moth in June and July.

Generally distributed. New York: Rock City (Cattaraugus County), Ithaca, New Windsor (Morton).

In var. **nephelotella** Hulst (*clemensalis* Dyar), the thorax and base of wings is pale and pinkish, almost as in *platanella*, but the darker, rather than paler, outer part of the wing and the narrower wing will distinguish it. Var. **expandens** Walker is transitional.

2. **T. subcanalis** Walker. Similar to the preceding species, antemedial line contrasting, blackish, preceded by a heavy blackish shade covering the tufts and the first antemedial line. Plume blackish. 22 mm. (*militella* Hulst, not Zeller.)

Illinois to Texas.

This is probably merely a variety of *T. asperatella.*

3. **T. melanogrammos** Zeller. Plume variable in color. Ground of thorax and base and outer part of wing dull gray, somewhat suffused with reddish and dusted with black; of median area white, dusted with black. Antemedial line double, black, white-filled, contrasting, a little irregular and a little farther out on inner margin; interrupted by the translucent patch in the cell of the male. Postmedial similar and equally distinct, its outer line suffusing into the gray outer region; somewhat sinuous and a little irregular, but not dentate; antemedial tufts black-tipped; medial tufts white, with some black scales at end of cell. 20 mm.

Larva on shrubby Leguminosæ (Gleditschia, Prosopis).

New Jersey, south and west. New York: New Windsor (Morton).

In the typical form, from the Southwest, the contrast between the dark base and pale median area is not striking, only the antemedial space being distinctly pale. Our specimens are variety **diluculella** Grote (*talleolalis* Hulst).

4. **T. militella** Zeller. Wings broad; plume black. Head, thorax, and base of wings dull red-brown, with a pinkish tint, and much darker than the outer part, which is also a little pinkish; many scales, especially on the under side, crimson-tipped. Antemedial line blackish, separated from base by a white line; straight and erect; no nearer the base on the costa. Tufts mostly brown; median area nearly white, especially toward the antemedial line; postmedial line a little paler gray and more diffuse, somewhat sinuous, and, when most distinct, dentate in the middle, followed with white, but with the outer part hardly darker and not contrasting. Tufts in median area pale; no distinct discal dot. 22 mm. (*platanella* Clemens.)

Larva on Platanus.

Generally distributed. New York: Ilion, Rhinebeck (Dyar), Onteora Mountain

5. **T. baptisiella** Fernald. Wings not very broad, plume blackish or yellow. Thorax and basal half of wing white, somewhat shaded with light red, especially the antemedial region; antemedial line white, dentate, mostly lost in the male; outer half of wing light red; postmedial deeply dentate, the teeth defined on the inner side with blackish, on the outer with white, especially in the middle of the wing; all tufts white, black-tipped; the antemedial one below **A** absent. Terminal line practically complete. Fore wing sometimes more or less suffused with gray, but the species always distinguishable by the deeply dentate postmedial line and the dentate antemedial, ending near the middle of the inner margin. No distinct process on male antenna; a small scale-tuft only. 20 mm.

Larva on Baptisia.

Seen from New Jersey, West Virginia, and west. "New York" (Fernald).

6. **T. humerella** Ragonot. Shining powdery gray. Postmedial far out, pale, defined with gray, with a blackish shade on the costa beyond it; antemedial less distinct and far out; tufts white, heavily black-tipped, contrasting, the base of the wing before them contrasting, whitish. Terminal dots heavy, sometimes confluent, alternating with heavy dark gray bars in the basal half of the fringe. 18 mm. (*formosella* Hulst).

Missouri.

7. **T. robustella** Zeller. Wings broad. Basal segment of antenna much enlarged, without a process; maxillary plume yellow in male. Basal third purple black, paler at extreme base, followed by an even, usually concave, fine, whitish antemedial line, cut by a small blister in the cell in the male; antemedial space pale gray, shading into the darker gray outer half. Postmedial strongly sinuous, pale, diffuse, terminal fine, broken; tufts black and white. 22 mm. (*scortealis* Lederer, *diluculella* Grote.)

Larva on pine.

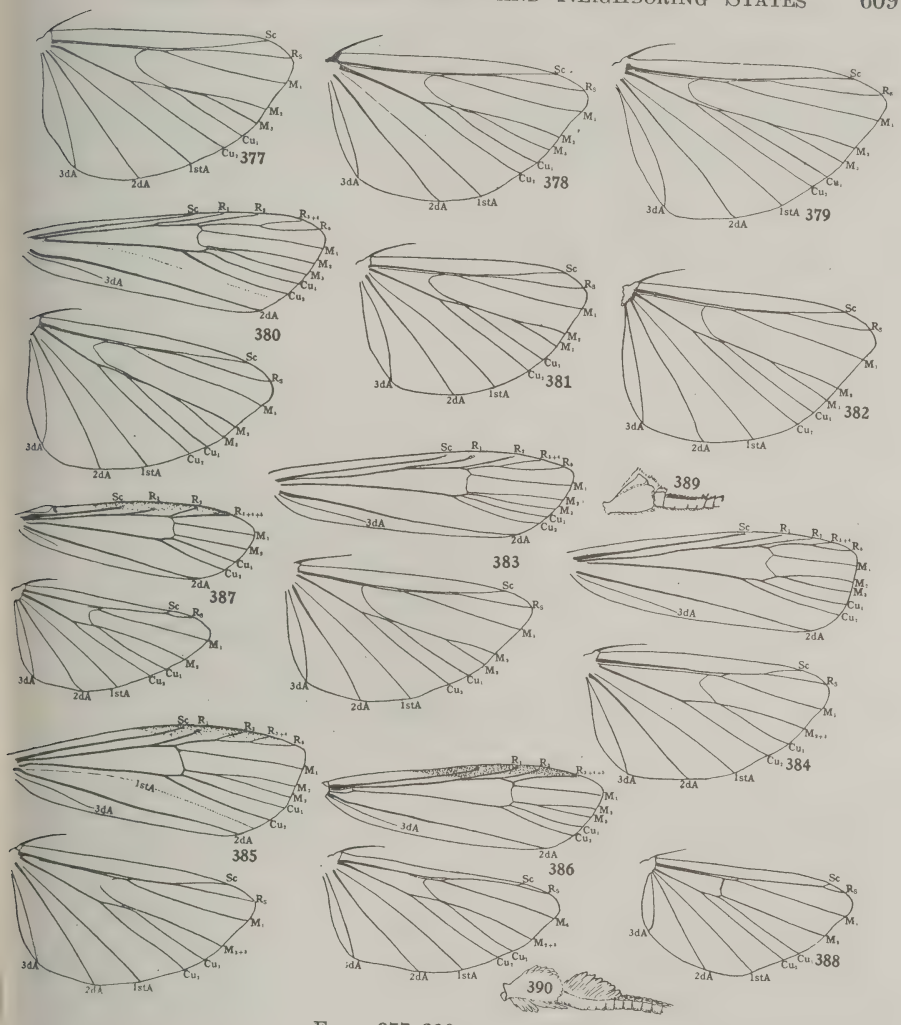
Apparently general but rarely taken.

Cœnodomus hockingii Walsingham (*Dyaria singularis* Neumœgen), a heavy Noctuid-like species with pectinate antennæ, from India, has been taken but once and is doubtless a stray introduction.

Subfamily **PHYCITINÆ**

(Phycinæ)

Head with antennal socket separated from eye by a complete line of scales; ocelli present; male antennæ often fasciculate, with the base of the shaft often curved and bearing a tuft of scales on the concave side (fig. 390); scape very rarely with a projection; antennæ often normal. Palpi often upturned, always large; maxillary palpi always well developed, in the male of some genera with long hair scales on the outer joints, forming a plume-like structure, concealed in a groove in the second segment of the labial palpus, which is in that case almost always closely upturned; tongue well-developed, the palpi curving out a little near the base, to make room for it. Fore wing with one radial lost, R_3 and R_5 stalked, R_2 usually free; rarely, with R_3 and R_5 completely united; **1st A** lost, **3d A** weak and free. Hind wing with **Sc** and **R** usually fused for a distance beyond the end of the cell, rarely closely approximate only; base of **R** as far as end of cell, often lost, making **Sc** appear to rise from the end of the cell; the free tip of **Sc** occasionally lost, and often very short, running directly across to the costa. Frenulum of female simple. Hind wing with a strong fringe of straight stiff hairs on base of **Cu** above; in many genera with one or two medials lost; middle discocellular typically strongly curved, the lower part often very closely approximate with the lower side of cell (base of Cu_1 and **M-Cu**), always formed as a normal tubular vein at the two ends; in the middle, sometimes very weak but never lost. M_1 usually stalked with **R** before **R** joins **Sc**, M_2 usually stalked

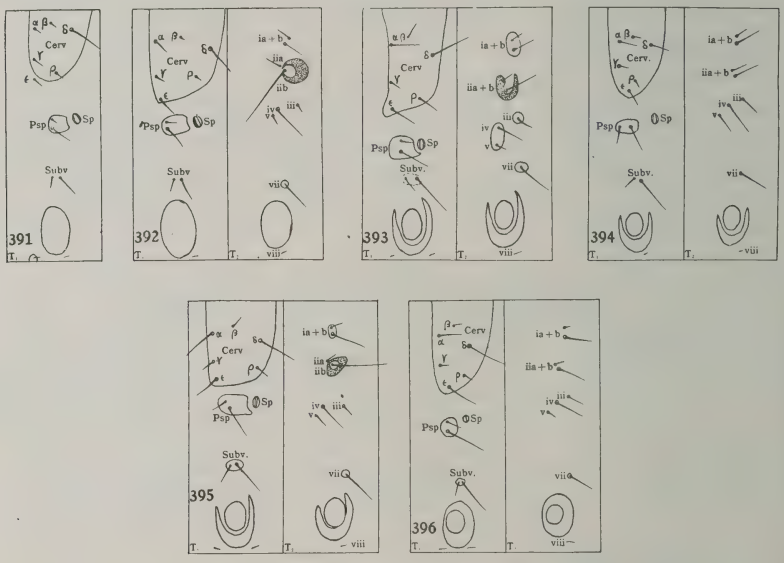


FIGS. 377–390. PHYCITINÆ

377, *Rhodophæa hystriculella* (Western States), venation of hind wing; **378,** *Acrobasis zelleri* (Europe), venation of hind wing; **379,** *Dioryctria* species, venation of hind wing; **380,** *Laodamia fusca,* venation; **381,** *Salebria contatella,* venation of hind wing; **382,** *Etiella zinckenella,* venation of hind wing; **383,** *Elasmopalpus lignosellus,* venation; **384,** *Euzophera* species, venation; **385,** *Canarsia ulmiarrosorella,* venation; **386,** *Moodna ostrinella,* venation; **387,** *Plodia interpunctella,* venation; **388,** *Homœosoma masinella* (Europe), venation of hind wing; **389,** *Acrobasis,* base of male antenna; **390,** *Laodamia fusca,* base of male antenna

with M_3; M_2 occasionally continuous with the outer part of the middle discocellular, and running closely approximate to M_3 for a considerable distance, but not fusing with it.

The larvæ (figs. 391 to 396) are very generally leaf rollers and crumplers, often living in a tube of silk mixed with frass, within the folded leaf; several species eat stored food etc., and become serious pests. They are distinguished from most



FIGS. 391–396. PHYCITINÆ

391, *Myelois cribrella* (Europe) seta map of prothorax of larva; **392**, *Acrobasis sodalella* (Europe), seta map of thorax of larva; **393**, *Dioryctria zimmermanni*, seta map of thorax; **394**, *Etiella zinckenella*, seta map of thorax; **395**, *Vitula edmandsii*, seta map of thorax; **396**, *Homœosoma nimbella* (Europe), seta map of thorax

other Pyralid larvæ by tubercle iii of the metathorax, which is normally enlarged, black with a white center.

The subfamily seems to be derived from the Pyralidinæ, perhaps through the Epipaschiinæ; the genus Omphalocera is a synthetic one, with the venation of the Pyralidinæ, the sex-scaling on the wings most characteristic of the Epipaschiinæ, and a common Phycid type of male antenna. Its larva is also rather Phycid than Pyraline.

The middle discocellular of the hind wing is of four principal types:

(1) Discocellular curved strongly above middle, the lower part long, oblique, meeting lower side of cell at a sharp angle, well beyond the origin of Cu_1, so that M_2 and M_3 appear connate. This type is represented by the genus Trachycera in Texas, but appears not to reach our area.

(2) Discocellular strongly curved, the lower part somewhat longer, meeting lower side of cell at a sharp angle not far from origin of Cu_1. (normally a little

beyond), not running closely parallel to lower side of cell. M_2 and M_3 more or less stalked. Cell moderate (for example, Acrobasis, fig. 378).

(3) Discocellular very strongly curved, its lower part approximate to the lower side of the cell for a greater or less distance before the origin of Cu_1, making Cu_1 appear stalked (for example, Dioryctria; Nephopteryx). The group may be divided into two subtypes; *a*, in Dioryctria (fig. 379), Ulophora, and Monoptilota, Cu_2 separates from the cell at a third of the length of the wing; *b*, in most of the other genera it separates two-fifths way out (fig. 380).

(4) Discocellular practically straight and transverse, a little broadened, and not tubular (M_2 lost) (fig. 388).

Many genera which have lost M_2 show a condition intermediate between types (2) and (4) (fig. 386).

Key to genera

1. Hind wing with all veins present, or with Sc weak (Cu apparently 4-branched); fore wing with all veins present (except the missing radial characteristic of the subfamily).
   2. Male antennæ notched and unipectinate.....78. **Monoptilota.**
2. Male antennæ not unipectinate.
   3. Palpi upturned or recurved, the last joint rarely porrect.
      4. Discocellular of type (2) (fig. 378).
         5. Male antennæ simple.
            6. Fore wing with M_2 and M_3 stalked.....74. **Myelois.**
            6. Fore wing with M_2 and M_3 separate.....74. **Rhodophæa.**
         5. Scape of male antenna strongly dilated or angulate at apex; rarely with a process much as in the Epipaschiinæ.....75. **Acrobasis.**
      4. Discocellular of type (3) (figs. 379, 380).
         5. Eyes small; palpi with first two segments long-hairy below. 81. **Polopeustis.**
         5. Eyes normal; palpi scaled.
            6. Male antennæ practically straight, but a little thickened with scales; palpi scaled, maxillary palpi without plume.
               7. Cu_2 of hind wing arising one-third way out (fig. 379).
                  8. Maxillary palpi of male flattened, closely appressed against the front.....76. **Ulophora.**
                  8. Maxillary palpi of male filiform.....77. **Dioryctria.**
               7. Cu_2 of hind wing arising two-fifths way out.
                  8. Maxillary palpi flattened, closely appressed against the face. 79. **Glyptocera.**
                  8. Maxillary palpi filiform.....82. **Ambesa.**
            6. Male antennæ more or less, usually strongly, curved at base, with a tuft of scales filling the concavity; maxillary palpi usually plume-like; Cu_2 arising from cell two-fifths of the way to margin of wing.
               7. Maxillary palpi filiform; labials without groove.
                  8. Fore wing with M_2 and M_3 stalked.....80. **Tacoma.**
                  8. Fore wing with M_2 and M_3 approximate.
                     9. Fore wing smooth-scaled.....83. **Nephopteryx.**
                     9. Fore wing with a scale ridge.....84. **Tlascala.**
               7. Maxillary palpi plume-like; rarely, forming a scaly tuft, enclosed in a groove in labial palpi.
                  8. Fore wing with R_2 shortly stalked, M_2 and M_3 stalked or connate; hind wing usually with Cu_1 apparently stalked. 85. **Meroptera.**

8. R_2 from cell; M_2 and M_3 often separate.
9. Middle discocellular curved far in, so that the lower part of it is continuous with the general direction of Cu_2; male antennæ curved at base.
10. Fore wing with basal scale-ridge.....87. **Immyrla.**
10. Fore wing smooth.....86. **Salebria.**
9. Discocellular decidedly more transverse than Cu_2.
10. Male antennæ flattened, with a strong tuft; front generally smooth; M_2 and M_3 of fore wing often closely approximated.
11. Palpi reaching barely up to base of antennæ..88. **Myrlæa.**
11. Palpi strongly overlapping base of antennæ. 89. **Laodamia.**
10. Male antennæ hardly flattened, with a weak scale-tuft; front with a strong tuft; M_2 and M_3 well separated (fig. 383).....90. **Elasmopalpus.**
3. Palpi oblique or porrect, with porrect last joint.
4. Second joint oblique, without a plume in male.
5. Cu_1 apparently from angle of cell in hind wing.....90. **Pyla.**
5. Cu_2 from very close to angle of cell.....91. **Epischnia.**
4. Second joint very long and straight, with a groove enclosing a plume. 92. **Etiella.**

1. Hind wing with M_2 lost (completely fused with M_3); **Cu** therefore apparently trifid.
2. R_3 and R_5 of fore wing stalked; **Sc** of hind wing generally distinct.
3. Hind wing with Cu_2 arising well back from angle of cell (five-sixths way out).
4. Palpi porrect or oblique, the third joint drooping or porrect.
5. Maxillary palpi large, scaly, exposed; basal joint of labials with a projecting tuft; tongue hidden; male antennæ pectinate, female subpectinate.....93. **Melitara.**
5. Maxillary palpi cylindrical; basal joint of labial palpi not projecting; male antennæ simple.....94. **Zophodia.**
4. Palpi ascending, sometimes recurved.
5. Hind wing with cell long, veins short (fig. 384).....95. **Euzophera.**
5. Hind wing with cell short, veins long.....96. **Vitula.**
3. Hind wing with Cu_2 arising very near angle of cell.
4. Fore wing with **Cu** apparently quadrifid.
5. Palpi ascending, curved, with ascending third joint.
6. Fore wing with M_2 and M_3 not in line with **Cu**.
7. R_2 from cell, M_2 and M_3 stalked; hind wing with **Sc** short. 97. **Lætilia.**
7. R_2 stalked with R_{3-5}, **Sc** of hind wing moderate, parallel to **R**.
8. M_2 and M_3 of fore wing stalked (fig. 385).....98. **Canarsia.**
8. M_2 and M_3 separate.....99. **Psorosina.**
6. Fore wing with M_2 and M_3 in line with **Cu**, stalked.....101. **Hulstia.**
5. Palpi oblique or porrect, third joint drooping.
6. M_2 and M_3 in line with stem of **Cu**.....102. **Honora.**
6. M_2 and M_3 distinctly out of line with stem of **Cu**, long-stalked. 100. **Valdivia.**
4. Fore wing with **Cu** trifid.....103. **Diviana.**
2. Fore wing with two radials completely lost; hind wing with **Sc** weaker, usually obsolescent.
3. Middle discocellular vein of hind wing of type (4) (fig. 388). 104. **Homœosoma.**

3. Middle discocellular of hind wing more normal, oblique and not flattened.
4. Hind wing with Cu_2 from angle of cell; Cu_1 and M_2 long-stalked. 106. **Ephestiodes.**
4. Hind wing with Cu_2 distant from angle of cell; cell mostly short; M_2 mostly free (fig. 386).
5. Fore wing with **Cu** quadrifid.....107. **Moodna.**
5. Fore wing with **Cu** trifid.
6. Palpi recurved.....105. **Ephestia.**
6. Palpi drooping.
7. Cell of hind wing short (fig. 387).....108. **Plodia.**
7. Cell half the length of the wing.....109. **Caudellia.**

74. *MYELOIS* Hübner

Antennæ simple, pubescent; front smooth, palpi smooth, upturned to vertex, tapering; maxillary palpi slightly rough, normal. Fore wing smooth, M_2 and M_3 distinctly stalked, not in line with **Cu**; hind wing with long cell; middle discocellular meeting lower side of cell at 30 degrees, just beyond origin of Cu_1.

Key to the species

1. **Sc** of hind wing long, nearly parallel to **R.**
2. Fore wing blackish; the base a little paler; markings obsolescent. 1. *obnupsella.*
2. Fore wing blackish, with distinct lines.
3. Hind wing pale, transparent.....3. *bilineatella.*
3. Hind wing dark.....2. *zonulella.*
2. Fore wing gray, shaded with dark brownish; the first line dilated into a large pale patch on the inner margin.....4. *bistriatella.*
1. **Sc** of hind wing very short, at a sharp angle to **R.**
2. Antemedial line straight, continuous, almost perpendicular.....5. *alatella.*
2. Antemedial line oblique, dentate.....β. *ceratoniæ.*

1. **M. obnupsella** Hulst. Gray, hardly brownish, lightly dusted with white; gathering to form a distinct, upright, antemedial pale shade, followed by an equally wide shade without any dusting. Fringe similar. Hind wing whitish, with dark veins, outer edge, and costa. 20 mm. (*subtetricella* Ragonot.)
May.
Canada to Florida.
In many specimens the postmedial line is distinctly indicated by a gathering of the white dusting.

2. **M. zonulella** Ragonot. Blackish gray; lines pale, edged with blackish; antemedial oblique, straight, reaching almost to middle of inner margin; the dark edging on outer side heavy; base of wing and outer margin paler. Postmedial line oblique, sinuous and denticulated; discal dots distinct, black; no terminal dots. Hind wing dark brown-gray, but paler than fore wing. 22 mm.
May. (Not seen.)
Northern Illinois.

3. **M. bilineatella** Ragonot. Fore wing blackish gray; antemedial line whitish, followed by a dark shade, nearly straight and erect; postmedial line sinuous and denticulate, toothed out at middle; discal dots forming a slight blackish bar; terminal dots obscure. Hind wing translucent with a little gray, like *obnupsella.* 21 mm.
June. (Not seen.)
New York.

4. **M. bistriatella** Hulst. Fore wing dark brownish gray, almost even; lines whitish, diffuse; antemedial line somewhat outwardly oblique, and widening to the

inner margin; base dusted with white; postmedial line diffuse, nearly parallel to outer margin, distinct; discal dots of the ground color, large, defined by white dusting. Hind wing like that of *M. obnupsella*. 20 mm.

New York to Florida, Wisconsin, and Colorado.

5. **M. alatella** Hulst of California has been reported from New Jersey, probably in error for some species of Homœosoma. It is powdery gray, with dentate antemedial and zigzag postmedial lines; outer part of cell whitish, with a dark shade below it.

6. **M. ceratoniæ** Zeller is injurious to dried figs and other stored food, in the Old World, and is to be expected in our territory. It is gray, with the usual pale lines, shaded with blackish; the inner line straight except for a large inward angle on **A**. 22 mm.

The last two species have more pointed wings than the typical group.

Rhodophæa exulella Zeller approaches our area on the south. It is near Acrobasis, but without the modified male antennæ. It is gray with crimson base; black discal dots; antemedial line pale and far out; and postmedial line heavily edged on both sides with fuscous.

75. *ACROBASIS* Zeller

(With *Mineola* Hulst)

Male antennæ with scape enlarged, with a pointed process or angle on inner side (fig. 389), sometimes produced as a short spur; shaft pubescent in male, sometimes sinuous at base, and slightly thickened with scales, often normal. Fore wing normal in venation, often with a heavy raised scale-ridge a short distance before the antemedial line, the space between it and the antemedial line often tinted with red. Hind wing (fig. 378) with discocellular vein of type (2), meeting the lower side of the cell at a sharp angle, but not always opposite the origin of Cu_1. Under side in many species with patches of black sex-scaling in the male. Palpi as in Myelois.

Acrobasis is a very difficult genus to work with. Several of the species are misidentified more often than not, and some may not be correctly placed in the analysis below.

Key to the species

1. Fore wing with a transverse antemedial scale ridge.
2. Fore wing of male, beneath, with a small black dash at base of costa (above **Sc**), or a larger streak not reaching the base.
3. Hind wing with black sex-scaling beneath.
4. Hind wing with two black streaks (on **R** and **Cu**, sometimes partly confluent).
5. Patch on **R** extending from base to beyond middle of wing, the outer half rather thicker ..... 1. *angusella*.
5. Patch on **R** not connected to base, or with the basal half represented by a very fine line; streak on **Cu** heavier ..... 2. *demotella*.
4. Hind wing with the streak on **R** only.
5. Fore wing with a streak on **R** from base to middle .... 3. *minimella*.
5. Fore wing with a short bar at base only.
6. Black streak on hind wing from base to beyond middle .. 4. *eliella*.
6. Hind wing with an oval spot at middle of costa.
7. Outer part of wing dark blue-gray ..... 6. *stigmella*.
7. Outer part of wing pale pinkish gray, contrasting with base. 5. *aurorella*.

3. Hind wing without black markings below in male.
4. Fore wing with a subcostal streak from base to middle.
5. Larva on hickory.....7. *caryivorella*, 8. *caryæ*.
5. Larva on oak .....9. *hebescella*.
4. Fore wing with a short subcostal bar at base only.
5. Fore wing whitish to about three-fourths way out on the costa, crossing the antemedial band.....10. *kearfottella*.
5. Fore wing whitish at base only, out to the antemedial band, or all gray .....11. *palliolella*.
2. Fore wing without any sex mark below.
3. Cell broad; M_2 and M_3 distant from Cu_1 and Cu_2.....19. *malipennella*.
3. Venation normal in both sexes.
4. An oblique white band from middle of wing beyond antemedial line to costa before postmedial line, containing the contrasting black discal dots .....13. *normella*.
4. Medial area all gray, only somewhat dusted with white at middle of costa.
5. Thorax, base of wing, antemedial area, and postmedial area toward inner margin all shaded with red. Larva on hickory
12. *latifasciella*.
5. Red practically confined to antemedial space; sometimes replaced with chocolate brown, or absent.
6. Larva on Comptonia; postmedial line almost obsolete; antemedial space usually bright Indian red in northern form.
15. *comptoniella*.
6. Larva on alder; antemedial area usually bright brick red; postmedial line distinct but a little diffuse; discal dots distinct.
14. *rubrifasciella*.
6. Similar; larva undescribed.....18. *irrubriella*.
6. Larva on birch; moth like *rubrifasciella*, but usually with the antemedial space deep brown; and the dark areas of the ground deeper brown, with distinct purple iridescence.....16. *betulella*.
6. Larva on hazel; moth nearly uniform gray, not shaded with white; antemedial space somewhat browner.....17. *coryliella*.
1. Fore wing smoothly scaled, the tuft replaced by a blackish first antemedial line.
2. Antemedial area with a red band.
3. Discal points united into a black lunule.....20. *tricolorella*.
3. Discal points separate, obscure.....21. *rubescentella*.
2. Antemedial area gray-brown and white only.
3. Dark gray, the discal points separate, in a contrasting white patch, forming a sort of ocellus.....22. *amplexella*.
3. Lighter; the discal spots not in a small patch, but often in a broad whitish area.
4. Antemedial lines starting from a heavy black triangle on costa; larva on Rosaceæ .....24. *indiginella*.
4. Costal black spot trapezoidal; larva on Vaccinium.....23. *vaccinii*.

I. *Fore wing with an antemedial scale ridge* (Acrobasis).

* *Male with black sex scaling beneath.*

1. **A. angusella** Grote. Head, thorax, and base of fore wing pale reddish. Scale ridge partly blackish. Antemedial line excurved, oblique outward to inner margin. Median area dark gray; marginal area shaded with reddish. Discal dots separate, darker; postmedial line fine, pale, excurved in middle, and indented in discal and submedian folds. Hind wing smoky, somewhat translucent. 22 mm.

Larva eating into growing points of hickory in the early spring, causing them to wither. Moth in June.

New York: West Farms? (type), Brooklyn.

This species has been called *nigrosignella,* and the species here discussed under the name of *eliella, angusella;* but in each case the sex-scaling of the under side of the hind wing was mentioned in the original description, making the present determination fairly certain.

2. **A. demotella** Grote. Similar to *A. angusella;* head white, thorax very pale; base of fore wing contrastingly paler than median area. Tuft gray, the gray area shading into the red about it. Antemedial band outwardly oblique, light red followed with cream color. Median area less mottled than in *A. angusella;* discal dots obscure; postmedial line fainter and marginal area less tinted with red. 20–24 mm.

Larva on black walnut, killing the buds as *A. angusella* does; dark olive brown; head, cervical shield, and tubercles shining dark brown. Moth in June and July.

Ontario to North Carolina, Pennsylvania, and Missouri. New York: Ithaca, West Farms.

This species is regularly correctly determined.

3. **A. minimella** Ragonot. Front and palpi reddish; thorax dark fuscous. Fore wing heavily overlaid with blackish on a light gray base; the blackish gathering in a large triangular costal patch beyond the antemedial line, which is pale gray, preceded by a black-centered, reddish ridge. Discal dots distinct; postmedial line obscure. 13–16 mm. (♂ *nigrosignella* Hulst.)

August.

Texas; also reported from North Carolina.

I suspect that northern records under these names are based on other related species.

4. **A. eliella** Dyar. Gray, powdered on a white base. Thorax and base of fore wing shaded with red; tuft blackish, followed by a broad orange-red and white antemedial band, followed in turn by a slight blackish shade on the costa. Discal dots joined; postmedial offset out in the middle, and finely denticulate, followed by a red shade concolorous with the antemedial one, except at the apex, where there is a weak oblique gray shade. 18 mm.

June and early July; August.

East River, Connecticut; New Brighton, Pennsylvania. New York: Ithaca.

5. **A. aurorella** Ely. Head and thorax gray. Basal third of fore wing blackish, strongly contrasting, its outer boundary but slightly oblique outward, reaching inner margin only a third way out. Outer part of wing pale gray, a little shaded with pinkish, and darkening to the outer margin. Discal dots small, blackish; postmedial line faint, paler. 20 mm.

July.

New York: Ithaca, Ilion.

6. **A. stigmella** Dyar. Purple-gray, much darker than *A. aurorella.* Head and middle of collar white. Scale-ridge slightly darker, followed by a faint reddish shade. Discal dots double. Postmedial line faint, paler in a darker shade. Disc of hind wing, below, overlaid with yellow scales. 18 mm.

May to August. Caterpillar a bud worm on hickory; gray green, with black head, cervical shield, and true legs; and with brown tubercles and anal plate.

East River, Connecticut; Fort Lee, New Jersey.

7. **A. caryivorella** Ragonot. Dark blue-gray, rather even, without any reddish or yellowish shading. Lines diffuse; paler, defined with dark, especially toward the median area; the antemedial bent at the middle. Discal dots strong, separate. 23 mm.

The caterpillar is found on hickory in early spring; at first working in a petiole, then in the top of a twig. It lives in a frass tube, the earlier, slender portion of which is serpentine; and transforms in a large oval cocoon.

Caterpillar dark gray or greenish black, with granulose red-brown head and yellow-brown cervical shield, and a large black and red subdorsal plate (ib) on the mesothorax. Moth in June.

East River, Connecticut, to Illinois, Missouri, and Texas.

8. **A. caryæ** Grote. Dark fuscous; thorax concolorous; base of fore wing somewhat paler. A slender pale-pinkish antemedial band beyond the scale ridge, but no other pinkish or yellowish shading. 18 mm.

June. Caterpillar a bud worm on *Carya porcina* in May, living in a slender frass tube; greenish gray, with dark brown head, shining yellow-green cervical shield, and light brown subdorsal plate on mesothorax.

Illinois. "New York" (Grote).

The original description and Ragonot's notes on the type make no mention of sex scaling. As determined in the Barnes collection, the male has a short black bar below the costa, followed by yellow scaling, and a streak the whole length of the cell, its base overflowing the cell and touching **A.** The species should be bred again from the characteristic larva.

9. **A. hebescella** Hulst. Dull yellowish gray-brown; head and thorax concolorous; scale ridge black; the other markings obscure. 18–20 mm.

Larva on oak (apparently in a folded leaf), pupating in a large egg-shaped cocoon.

East River, Connecticut, to Texas.

10. **A. kearfottella** Dyar. Similar to *A. palliolella*, with a large whitish basal area, extending across the antemedial line to the middle of the wing, giving a suggestion of *A. indiginella*, but without the black antemedial costal triangle. Some reddish scaling about the scale ridge.

July and August. Larva leathery, brown; in a somewhat flattened case of grayish silk with some pellets of frass. Cocoon at the end of the case, oval, 20 mm. by 6 mm. by 4 mm. Food, hickory.

Distribution uncertain. New York: Ithaca.

11. **A. palliolella** Ragonot. Dark mouse gray, becoming blackish on the middle of the costa. Head, thorax, and base of fore wing typically white, somewhat shaded with some buff or orange shading; the outer boundary nearly straight and strongly oblique, to middle of inner margin. In a variety which commonly passes for *nebulella* the base is nearly concolorous, leaving a reddish antemedial area on the inner margin. 20 mm. (*juglandis* LeBaron; *albocapitella* Hulst, *nebulella* Hulst, etc., not Riley).

July. Larva on walnut and pecan.

Ontario to Florida, Illinois, and Texas.

The gray form of this species may be *A. sylviella* Ely, which is unknown to me.

*** Male without black sex-scaling below.*

12. **A. latifasciella** Dyar. Superficially exactly like *A. eliella*, but without sex scaling below. 19 mm.

This species has passed for *caryæ* in some collections.

June and early July; August. Larva on hickory.

New Brighton, Pennsylvania; Maryland; Virginia; Missouri.

13. **A. normella** Dyar. Pale gray with a slight reddish suffusion; scale ridge large and dark, with a slight pale reddish shade beyond it; a diffuse antemedial costal gray triangle; costa and cell shaded with white before and beyond it, as far out as the postmedial line, which is normal; discal dots black, contrasting, separate. 19 mm.

End of July and early August.

East River, Connecticut.

14. **A. rubrifasciella** Packard. Closely similar to *A. comptoniella*, but on the average a little smaller, narrower-winged, with rather brighter markings, and more frequently (but not always) with a red antemedial band. 21–24 mm.

Caterpillar brown with a rosy tint; with rough darker head, and shining blac mesothoracic plates; on alder and hazel, living between two or three leaves in conical case of frass lined with silk.

Distribution unknown. Indistinguishable except by breeding.

15. **A. comptoniella** Hulst. Fuscous gray, rather lighter and bluer toward th base, and on the costal half of the median area. Tuft blackish-brown, followed b a dull Indian-red shade, and sometimes by a pale antemedial line. Discal dot separate and black; postmedial line faint. 25 mm.

Caterpillar blackish, with broad diffuse pale reddish dorsal and lateral bands head dark red, black in the sutures; cervical shield pale red, contrasting; fee black. It feeds on sweet fern and on bayberry; in an oval case with a soft slende neck; lined with silk and covered more or less with bits of leaves, etc.

Maine to New Jersey. There is a race, or closely related species, on Myrica i Florida. This form is doubtfully distinct from *A. rubrifasciella*, and determinabl only by breeding.

New York: Rhinebeck.

16. **A. betulella** Hulst. Similar to *A. comptoniella*. General wing surface shade with reddish and dusted with white, but without a red antemedial band.

End of July. Caterpillar on black and white birch, in a case similar to that o *comptoniella* but almost wholly of silk.

Maine to New York; Colorado; California. Probably a food variety of *A comptoniella*. New York: Ithaca.

17. **A. coryliella** Dyar. Gray, not shaded with white, nearly even; antemedia band slightly browner, pale-edged, with a darker shade beyond it at costa. Post medial line a little more distinct, finely crenulate.

June to August. Larva in the usual case on hazel (Corylus); pupa in a dens hard oval ichneumon-like cocoon.

18. **A. irrubriella** Ely. Similar to *A. latifasciella;* head and thorax not s reddish; band beyond the scale ridge narrow; only slightly marked with orange red; outer line more even, not followed by an orange-red shade. 19 mm.

July.

East River, Connecticut.

19. **A. malipennella** Dyar. Male fore wing short and broad, with distorted venation and m-cu very long. Gray thorax tinged with copper-red; scale ridg short and black; a white triangular shade in median area, as in *A. normella* containing a single black discal dot. 12 mm.

East River, Connecticut.

This type is unique, and may be a monstrosity of *A. normella.*

II. *Fore wing smooth-scaled* (Mineola).

20. **A. tricolorella** Grote. Wings irregularly black-dusted on a white base appearing mottled gray. Antemedial line black, forming a triangular shade on costa; a triangular reddish patch before it on inner margin, deepening to black basally, and preceded by a white line. Discal lunule contrasting, black, in a pale shade; a darker medial shade joining the postmedial line at the discal fold; post medial line pale, edged within with black, and followed by a chestnut band. A blackish apical streak to costa. Head and collar dark red; thorax grayer.

Quebec and Maine to California. New York: Catskills.

21. **A. rubescentella** Hulst. Gray, shaded with reddish, with two inconspicuous darker discal dots, and a reddish antemedial band. 25 mm.

Tennessee.

22. **A. amplexella** Ragonot. Blackish gray, with a large well-defined white patch at middle of costa, containing the sharply defined black discal points. Antemedial line single, diffuse, white, oblique outward; postmedial black, indented in the discal fold as usual, followed by white scales, and with a little white scaling just before the margin. Hind wings and body browner. 15 mm.

Quebec to Texas.

23. **A. vaccinii** Riley. Similar to *M. indiginella;* rather smaller; under side of costa of male with yellow sex scaling. Upper side more contrastingly marked, with considerable white on costa, and inner antemedial band heavily black, the costal black antemedial spot not so neatly triangular. Discal dots well separated. Red shading more diffuse than in *A. indiginella.* 16 mm.

August. Larva variable in color, with shining yellow head, and paler cervical shield and anal plate; in berries of Vaccinium (blueberries and huckleberries); often injurious. The moth flies over the bushes, and is easily flushed in the daytime.

Massachusetts to Texas.

24. **A. indiginella** Zeller. Pale gray, dusted on a white base; a broad antemedial black triangle on costa, with two fine divergent lines running from it to the inner margin, enclosing a red-shaded area. Base also shaded with red. Median area shaded with dark gray below, and toward the postmedial line; which is pale, defined with dark gray and moderately irregular. A black discal bar, in variety **nebulella** Riley broken into two dots. A small triangular subterminal black shade at costa. 17–22 mm. (*Phycita nebulo* Walsh). (H. p. 409 f. 228–229.)

Caterpillar dull olive, with dark red-brown head and blackish shields; webbing the leaves together in the spring, and living in a frass tube. The young caterpillar hibernates. The species is sometimes injurious to apple, and eats most other Rosales also.

Moth in July.

Generally distributed. New York: Ithaca, Big Indian Valley, Schenectady, Albany.

76. *ULOPHORA* Ragonot

Similar to Dioryctria. Antennæ simple, a little thickened toward the base, not curved; palpi upturned beyond vertex, maxillary palpi in the male rough, flatly scaled, compressed against the smoothly scaled front. Fore wing with a scale-tuft before the antemedial line.

1. **U. groteii** Ragonot. Fore wing brown at base, shaded with dark gray-green, especially beyond the tuft; outer part light gray, powdery, heavily shaded or overlaid with blackish; lines concolorous, heavily edged on both sides with dark slate gray; the antemedial convex, at the middle of the wing, the postmedial strongly bent out at middle, concave above and below, located far out; raised tuft very heavy, blackish; discal dots black, the lower one contrasting. Hind wing of male bright coppery luteous, with dark margin, of female, dull and darker. 18 mm.

July and August.

North Carolina; Florida.

2. **U. tephrosiella** Dyar. Base powdery light gray, shaded with dark gray; a brown band before the antemedial line, which is at the middle of the wing, and is paler, followed with blackish; outer half deep gray, with paler normal postmedial line, both lines defined with blackish. 15 mm.

Larva on Tephrosia.

North Carolina.

U. brunneella Dyar, also from North Carolina, the area before the antemedial line is black.

77. *DIORYCTRIA* Zeller

(With *Pinipestis* Hulst)

Male antennæ nearly straight, usually with a little raised scaling on the inner side at the base of the shaft; sometimes serrate; scape rounded, curved, with a slight scale tuft only. Palpi upturned to beyond vertex; maxillary palpi cylindrical, porrect, rough-scaled. Fore wing normal; in group Pinipestis with raised scaling, normally forming antemedial and medial rough ridges. Hind wing of

type 3a (fig. 379); discocellular approximate to lower side of cell from near origin of Cu_2, or just beyond. **Sc** and **R** approximate.

The larvæ (fig. 393) so far as known are all borers in Coniferæ, usually under the bark of the twigs, or in the cones; causing more or less exudation of pitch. Sometimes they feed externally, concealed in a tube formed of pitch and frass. Several are serious pests.

Key to the species

1. Fore wing smoothly scaled (Dioryctria) ..... 4. *reniculella*, 5. *abietella*
1. Fore wing with raised scale ridges or tufts; gray shaded with reddish (Pinipestis).
   2. Postmedial line with indentations in discal and submedial folds nearly equal; small with slight median scale ridge (18 mm.) ..... 3. *pygmæella*
   2. Postmedial line with discal notch slightly deeper; a very heavy median scale ridge; large (25 mm.) ..... 1. *zimmermanni*
   2. Postmedial line deeply toothed in opposite cell; antemedial line reaching margin at middle of wing, strongly oblique (25 mm.) ..... 2. *clarioralis*

1. **D. zimmermanni** Grote. Gray, shaded with reddish, especially toward the base, and with blackish; the two scale ridges blackish, the median one very heavy. Lines pale gray, defined on both sides with blackish, more strongly toward the median area. Antemedial line zigzag, hardly farther from base on inner margin than on costa; discal dot pale, diffuse, but contrasting; postmedial line denticulate, moderately angled in opposite cell, and very slightly so on fold. Terminal space rather paler and more gray; terminal line somewhat broken, black. 28 mm.

August.

Larva injurious to pine, working by preference under the bark of small branches, causing the pitch to ooze out. Cocoon usually formed in a mass of pitch. Sometimes seriously injurious. July. Doubtless there is a second brood in the fall, emerging the following spring.

. Hampton, New Hampshire, to Pennsylvania. New York: reported from Oswego County, Gowanda, Cheektowaga, Hamburgh, Clarence Center, Buffalo, Schenectady, Karner, Hastings.

2. **D. clarioralis** Walker. Similar to *D. zimmermanni;* antemedial line strongly oblique, only a little sinuous, and not angled on fold, reaching inner margin at middle; outer line with tooth in discal fold almost as deep as wide, merely dentate below. Discal spot obscure. 28 mm. (*zimmermanni* Hulst, not Grote.)

"United States" (Walker). Seen only from Florida, and probably confined to the South.

3. **D. pygmæella** Ragonot. Similar to *P. zimmermanni;* much smaller, median scale ridge hardly raised; a distinct blackish shade between the discal bar, which is pale, and the costal end of the outer line; antemedial line zigzag, erect, preceded by a broad deep orange band toward the inner margin. 18 mm.

North Carolina; Florida.

4. **D. reniculella** Grote. Ash gray, crisply powdered with black on white, with a slight brown tint to the darker parts; especially in rubbed specimens; base and terminal space paler; antemedial space solidly dark gray; the lower half of the median area also with a dark patch. Lines whitish, somewhat dusted with gray, heavily defined with dark gray; antemedial line erect, somewhat dentate; postmedial line diffuse, notched in the discal fold, and slightly concave below; discal dot a distinct upright oblong spot. 25 mm. (*abietella* of Hulst, in part.)

Larva injurious to spruce; its habits much like *D. zimmermanni;* very often working in the young cones. Moth in August.

White Mountains, New Hampshire, to Colorado and south. A variety in Florida. New York: Ithaca.

5. **D. abietella** Fabricius. Closely similar to *D. reniculella*, but averaging a little larger. 25–28 mm.

Distribution uncertain; well-known in Europe, where it has the habits of the preceding.

Two broods, the second perhaps partial.

Our records are partly based on the preceding species; part are correct. I can give no tangible differences between the two species.

78. *MONOPTILOTA* Hulst

(*Dioryctria*, in part)

Similar to Dioryctria; maxillary palpi small, but slightly plumose; male antennæ with scape enlarged, shaft strongly curved at base, the curvature filled with scales on the inner side, unipectinate on outer side nearly to apex. Fore wings smooth.

1. **M. nubilella** Hulst. (Lima-bean vine borer). Fuscous, shaded with whitish, especially over and beyond the cell, and somewhat streaked with blackish; antemedial line indicated by blackish streaks; postmedial line normal, very faint, pale; discal dots a little lengthened, not contrasting. Hind wing translucent in male, dark in female. 23 mm.

Larva producing gall-like swellings in the stems of lima beans, usually about two or three feet above the ground. Stout, blue-green, with a pinkish overlay on the dorsum; head brown, shading into black on the mouth parts; cervical shield olive brown; anal plate pale yellow, with four black dots. Tubercles pale. Pupa in the earth. Larva mature in July; moth in August and September. There is a partial second brood late in the fall.

Maryland to Florida and Arizona.

79. *GLYPTOCERA* Ragonot

(*Nephopteryx*, in part)

Male antennæ with shaft toward base slightly hollowed, forming a longitudinal groove, edged on both sides with scales. Labial palpi normal; maxillary palpi quite large, rough and thick; appressed to the frontal tuft. Venation normal; hind wing of type 3b.

1. **G. consobrinella** Zeller. Tuft represented by a few raised scales. Fore wing pale ash gray; base whitish, more or less overlaid with Indian red; a strong blackish shade before the antemedial line; which is pale, bidentate irregularly, and defined with black, two-fifths way out. Postmedial line similar, somewhat sinuous and crenulate, at four-fifths the length of the wing; a heavy black discal bar, with some blackish and dull red shading below it. 20 mm.

End of May to August.

Quebec to Texas. New York: McLean.

80. *TACOMA* Hulst

Wings normal; male antenna with a curve in the shaft, filled with a large scale tuft; scape simple. Palpa upturned to vertex; maxillary palpi large, filiform. Fore wing with M_2 and M_3 stalked; discocellular vein bent before origin of Cu_2.

1. **T. nyssæcolella** Dyar. Powdery gray; antemedial line whitish, offset a little on **Cu.** with a more evenly gray patch before it on inner half, and beyond it on costal half, the rest of the line defined with dark; a pale shade beyond it on inner

margin. Postmedial line pale, defined with dark, normal, with a large dark patch before it on inner margin. Hind wing paler. 20 mm.

May; July and August. Larva black, with a yellow head; in a loose web containing suspended frass, in a folded leaf of Nyssa.

Southern New Jersey to western Pennsylvania.

81. *POLOPEUSTIS* Ragonot

Male antennæ rough and obscurely dentate, pubescent; palpi relatively short, upturned, not exceeding the vertex; first two joints long-hairy, the third short and cylindrical; maxillary palpi slender. Fore wing more triangular than usual, with M_2 to Cu_2 free and parallel; hind wing with moderate cell (Cu_2 at two-fifths), M_2 and M_3 very long-stalked, angle of discocellular between Cu_1 and Cu_2. Moth diurnal.

1. **P. annulatella** Zetterstedt. Black, dusted with white, appearing light gray; lines pale, defined with dark, converging toward inner margin; antemedial line nearly straight; postmedial irregular. Hind wings very pale brownish, darker in female. Male 24, female 20 mm.

Arctic Eurasia; Altai; Labrador (?).

The Labrador specimen, determined as *annulatella* in the Hulst collection, is a Nephopteryx, and apparently a small eastern race of *N. fasciolella.*

82. *AMBESA* Grote

Like Nephopteryx, male antennæ flattened and slightly thickened at base, but without the notch and tuft of scales.

1. **A. busckella** Dyar. Powdery gray, slightly reddish, especially at base and on thorax. Base pale, followed by a diffuse blackish band, wider on the inner margin, the band lying before the antemedial line toward the inner margin and beyond it at costa, sometimes obliterating it. Lines doubled, dentate, antemedial line fully two-fifths way out, and farther out on inner margin; postmedial line well out, normal, its blackish edging somewhat wider on costa. A black reniform, and some blackish postmedial shading. Hind wing translucent at base. 22 mm.

July.

Maryland; western Pennsylvania.

83. *NEPHOPTERYX* Hübner

Male antennæ simple or serrate, with a more or less developed curve in base of shaft, filled with a mass of large scales. Front swollen, rough-scaled; palpi upturned beyond vertex, normal, the maxillary palpi normal, or with a flat tuft of scales applied to the face as in Ulophora. Wings smooth-scaled. Fore wing with R_2 free in our species, M_2 and M_3 separate but rather approximate, not in line with Cu. Hind wing with Sc and R closely parallel; M_1 stalked, M_2 and M_3 stalked; dcv of type 3b, becoming approximate to lower side of cell at or beyond origin of Cu_2, which is at two-fifths the length of the wing. Prothorax below with large scales, as in Ambesa, but unlike Dioryctria.

Key to the species

1. Ground dusted with white on clear black, appearing bluish ash gray.
   2. Each scale with a white base and a fine white tip; apparently very finely powdered ..... 2. *rhypodella.*
   2. Most of the scales either wholly black or wholly white ..... 1. *ovalis.*
1. Ground fuscous, dusted with black, and broadly white-tipped, scales.

2. Antemedial line very obscure and even.....3. *inquilinella.*
2. Antemedial line obscure and diffuse, but distinctly dentate....4. *modestella.*
1. Ground largely bright brown.....5. *rubrisparsella.*

1. **N. ovalis** Packard. Tuft on male antennæ twice as large as scape in front view. Powdery ash gray, rather coarse; the antemedial space typically, but not always, brown or yellowish; antemedial line waved, defined on inner side by the brown antemedial area, on outer side mostly by a blackish bar at costa and dots on veins; postmedial line normal, pale, only partly defined with blackish before it and fuscous beyond, but with heavier black edges at costa; some blackish shading near middle of wing; two black discal dots. Hind wing fuscous, not paler. 25 mm.

Late July and August.

Maine to California. New York: Rhinebeck, Delmar.

Variety **geminipunctella** Ragonot, with ground largely white, was described from Washington.

N. fascicolella Hulst, described from British Columbia, is similar to *N. ovalis*, but without any brown shading, and with only a little blackish shading along the antemedial line. Tuft on antenna no larger than scape. 30 mm. A small form of this (22 mm.) appears to occur in Labrador, and has been mistaken for *Polopeustis annulatella.*

2. **N. rhypodella** Hulst, another western species, almost evenly and very finely powdered black and white, with traces of markings; has been reported from Illinois.

3. **N. inquilinella** Ragonot. Similar to *N. modestella;* the markings more diffuse, antemedial band nearly erect and even. 18–24 mm.

Larva in willow galls (*Salicis nodum*).

Wisconsin.

4. **N. modestella** Hulst. Tuft on antenna large. Fore wing fuscous, somewhat dusted with white, especially about the end of the cell, and with a few black scales, antemedial line pale, diffuse, well out, reaching the inner margin almost at the middle of the wing, twice dentate, defined with blackish on outer side, especially on the veins, and with a broad brownish band before it. Discal dots black, distinct but not strong; postmedial line pale, normal, hardly defined with dark. Outer part of wing slightly reddish shaded. 20 mm.

Massachusetts.

5. **N. rubrisparsella** Ragonot. Ochreous brown, more or less suffused with pinkish; base solidly light; antemedial region suffused with blackish; antemedial and postmedial lines luteous, black edged; median area more or less shaded with black; discal dots black, strong; terminal space evenly pale, with black terminal dots, and a line in the fringe. 18 mm.

The typical form, from Texas, has the blackish shadings replaced with lighter ash gray. I have not seen the male.

August. Larva on Celtis.

Jefferson County, West Virginia; Texas.

84. *TLASCALA* Hulst

(*Nephopteryx,* in part)

Similar to Nephopteryx. Fore wing with a more or less developed ridge or scale-tuft before the antemedial line, sometimes with other markings more or less raised.

Key to the species

Base of fore wing concolorous.....1. *finitella.*
Base of fore wing redder and darker.....2. *reductella.*

1. **T. finitella** Walker. Dark powdery gray, somewhat brownish; antemedial line raised, blackish, obscure; tuft heavy, blackish; a series of small medial blackish tufts; discal dots black and tending to be confluent; postmedial line normal, pale, defined with dark, not conspicuous. A broken black terminal line as usual. Tuft on antenna very large, much more than filling the notch. 25 mm.

May.

Nova Scotia to Florida and Colorado.

2. **T. reductella** Walker. Wings pale gray, in part often almost white; postmedial line slightly paler, normal, dentate, defined by slightly darker gray on outer side. Base of wing and thorax brown (in variety **gleditschiella** Fernald, mouse gray); the tuft black, and not strong. Antemedial line heavy, black, outwardly oblique, and a little wavy, preceded by a pale line; discal dots black; no raised median tufts. 22 mm.

The larva webs together leaves of Gleditschia in September, emerging in late fall or the following May. Cocoon in rubbish on the ground.

New York to Ohio. New York: New Windsor.

85. *MEROPTERA* Grote

Like Salebria, our species with R_2 stalked, M_2 and M_3 clearly stalked; wings smooth-scaled.

1. **M. pravella** Grote. Ash gray, base contrastingly pale gray, with an even, slightly oblique outer boundary, followed by a strong blackish shade. Basal angle reddish. Discal dots blackish, tending to fuse, in a paler area; postmedial line pale, defined with darker gray, distinct but not contrasting. Terminal line continuous, black, weak. 20 mm.

March to May. The larva is said to be brown, with dorsal and lateral green lines, plain brown cervical shield, and head green, brown, or reticulate with black; in a web between two leaves of willow, or on *Rhus Cotinus, in September.*

Maine to British Columbia and Texas. New York: Lancaster, and New Windsor.

2. **M. unicolorella** Hulst. Mouse gray, slightly violaceous; markings obscure, but normal so far as traceable; antemedial line darker; postmedial paler, both diffuse. 22 mm.

Late May to August.

Montreal, Canada, to Florida and Texas (not Washington, as stated by Ragonot). New York: Ithaca.

3. **M. uvinella** Ragonot, as described, is paler than *M. pravella,* with the postmedial line white, clear, and straighter in the middle part. 16 mm.

United States.

Probably a mere variant of *M. pravella. M. cviatella* Dyar appears to be a Salebria.

86. *SALEBRIA* Zeller

(*Meroptera,* in part; with *Pempelia*)

Similar to Nephopteryx. Maxillary palpi yellow, plume-like, enclosed in a groove in the second joint of the upturned labial palpi. Fore wing normal; hind wing (fig. 381) with moderate cell, Cu_2 apparently from angle. Wings smooth in our species. Antennæ in our species smooth beyond the tuft.

Key to the species

1. Antemedial line followed by a pale patch on inner margin (obscure in some specimens of *contatella*).
2. Wholly blackish otherwise ..... 3. *engeli.*
2. Basal area contrastingly darker gray, at least toward the inner margin. 2. *annulosella.*

2. Markings very clean-cut; extreme base blackish, with a red shade before the antemedial line.....1. *turpidella.*
2. Whole basal area reddish.....6. *vetustella.*
2. Base mostly light gray, reddish at basal angle.....5. *contatella.*
1. Antemedial line not followed by a pale patch on inner margin.
2. Base distinctly paler.
3. Base yellow or reddish.
4. Followed by a strong antemedial line, outer part blue-gray.
5. Costa and inner margin broadly brown.....11. *cviatella.*
5. Outer two-thirds entirely gray.....10. *basilaris.*
4. Antemedial line obscure,
5. Base mostly yellowish.....8. *lævigatella.*
5. Base yellowish toward inner margin only.....7. *celtidella.*
3. Base lighter gray without any yellow or brown.
4. Antemedial space blackish.....9. *semiobscurella.*
4. A double black antemedial line toward inner margin only. 13. *purpurella.*
2. Base not paler than outer part of wing.
3. Antemedial region, and dark shades defining the postmedial line, strongly shaded with crimson.....12. *carneella.*
3. At most, with crimson streaks between the veins.
4. Pale antemedial line strongly waved on fold and on **A**.....5. *contatella.*
4. Antemedial line almost straight on lower half of wing.....4. *afflictella.*

1. **S. turpidella** Ragonot. Powdery gray, the lines hardly paler, sharply edged on both sides with black; the first line zigzag, normal, the second normal, rather more irregular than usual. Discal bar continuous, black; a blackish median shade below it toward inner margin; terminal line continuous, black; a slight brownish shade in the fold before the antemedial line. 18 mm.

Massachusetts and Colorado.

Distinguished from all other species in the genus by its absolutely clean-cut markings.

2. **S. annulosella** Ragonot. Mid-tibia blackish with a contrasting pale tip, basal segments of abdomen transversely banded with black. Scale tuft on antenna twice as long as scape. Fore wing light gray, with blackish shades beyond the antemedial line at costa, before it at inner margin, over costal end of postmedial line, and sometimes covering most of the base; antemedial line obscurely paler; postmedial faint, normal, preceded by a slight darker shade. Discal dots separate, black, contrasting; terminal dots separate. 18 mm.

The pale patch beyond the antemedial line is often obsolete in light specimens, but the species differs from *afflictella* in the nearly obsolete, diffuse, antemedial line, and the much fainter postmedial.

Massachusetts to Texas and Colorado.

Northern records are possibly in error for *S. engeli.* The form with the base shaded with brown is variety **pumilella** Ragonot; the type form has a blackish base, while those with concolorous base are variety **nubiferella** Ragonot.

3. **S. engeli** Dyar. Abdomen not banded with black. Dark fuscous, the markings more or less obsolescent, except for a large whitish dorsal patch over and beyond the antemedial line, sometimes continued across to the costa. Some pale scaling about the discal dots. Postmedial line traceable, pale. Tuft on antenna hardly larger than scape. 18 mm. (*annulosella,* in part).

May to July.

New Jersey to Texas.

4. **S. afflictella** Hulst. Base fuscous, out almost to the middle of the wing; crossed by a strong whitish basal line; antemedial line whitish, fine, a little waved,

followed by a clean-cut fuscous line. Median area whitish, outer third fuscous, crossed by a fine wavy normal postmedial line, the outer margin gray. Discal dots black, distinct. Terminal line black, almost continuous. Tuft on antenna more than twice as long as scape, not very broad. 16 mm. (*liquidambarella* Dyar).

The fuscous areas all show a slight reddish iridescence.

Larva on sweet gum.

Northern New Jersey to Florida.

5. **S. contatella** Grote. Middle tibiæ pale, with a dark annulus toward tip. Fore wings powdery gray, base shading into reddish near basal angle, median area typically suffused with mouse gray, leaving a vague pale patch on inner margin beyond the antemedial line; in light specimens, concolorous with the base, with only a vague gray median shade from the discal dot to the inner margin. Antemedial line whitish, zigzag, preceded by a heavy blackish shade and followed by a fine blackish line, thickened on **Cu** and **A**; or reduced to black wedges on **Cu** and **A**; postmedial line normal, doubly defined with darker gray; discal dots a little diffuse and tending to fuse. A broken black terminal line. Ordinary lines often nearly obsolete. Hind wing pale yellowish. 20–28 mm. (Probably *subcæsiella* Clemens.)

In variety **quinquepunctella** Grote (*virgatella* Clemens) there are brown, reddish, or yellowish streaks between the veins, cutting up the blackish markings into dots or streaks on the veins.

May to early July; August. Larva green, head black or reticulate with brown; cervical shield black or spotted with black; body turning red before pupation. On locust and wistaria between two leaves, in June and July.

Maine to West Virginia and west to Colorado; the variety with as wide a range as the type form. New York: Peru, Ithaca, Albany, New Windsor.

6. **S. vetustella** Dyar. Gray, somewhat paler on the inner margin beyond the antemedial line. Base dull orange-brown; a large blackish fascia before the antemedial line, narrow on costa, separated from the brown base by a narrow pale band. Antemedial line outwardly oblique, a little dentate, pale filled, its inner line fused with the black antemedial space. Wing beyond cell a little reddish, with an obscure normal, pale postmedial line, two darker discal dots, and nearly continuous terminal line. 22 mm.

New York and Maryland to Illinois.

7. **S. celtidella** Hulst. Ground light ochreous, the whole middle half suffused with fuscous gray; base toward inner margin shaded with tawny, followed by a luteous shade; antemedial line fully out to middle of wing, pale, defined with blackish, abruptly offset in, and defined by black dots on each vein. Discal dots black, well separated, the lower one in the upper part of a vague area of the pale ground color; postmedial line irregular and deeply dentate, defined on inner side by black dots and on outer by strong black wedges; terminal space contrastingly pale; a strong broken black terminal line. 18 mm.

August. Larva joining leaves of Celtis; not forming a tube. Body striped evenly in two shades of green; head and cervical shield piceous black, with two whitish stripes on each; tubercles black.

New England and central Illinois to Florida.

8. **S. lævigatella** Hulst. Almost even fuscous, slightly powdery, with a few white scales at lower angle of cell; antemedial line indicated by a double or triple blackish shade on inner margin at one-third way out, separated by whitish scales; base before it reddish; discal dots, postmedial line, and terminal line obscure. 25 mm. Male not seen.

Quebec; Massachusetts; Wisconsin.

9. **S. semiobscurella** Hulst. Slightly smaller than *Meroptera pravella*, but practically identical in markings; the blackish shading a little lighter, and the antemedial line usually distinct. Base of inner margin distinctly reddish. 20 mm.

July. Larva on sumac. Perhaps one of the two very different larvæ described for *M. pravella* belongs to this species.

New York and Texas.

10. **S. basilaris** Zeller. Bluish ash gray, base light wood-brown or orange, shading into blackish along the inner margin, or followed by a black shade; antemedial line strong, whitish, a little wavy, defined on outer side with a black line, fading out at costa. Outer margin shaded with brown, the brown varying a good deal in amount; discal dots and postmedial line obscure; terminal line distinct, broken, black. 25 mm.

July.

New Hampshire and northern Ontario to Colorado and Texas.

11. **S. cviatella** Dyar. Base, costa, and inner margin broadly bright reddish brown, disc and outer margin bright purplish gray with paler veins; a broad black inner band, cut by a fine white irregular line; discal dots confluent, clouded; outer line whitish, diffuse, sharply bent opposite cell and in fold. Black terminal dashes. 22–25 mm.

Chicago, Illinois.

12. **S. carneella** Hulst. Powdery gray; the thorax, base of wing, antemedial band, and postmedial region suffused with crimson; median area with crimson shades between the veins; lines normal; antemedial excurved and hardly dentate, gray, defined mostly by the lack of crimson suffusion; discal dots obscure, blackish, terminal line obscure and fine. 22 mm.

Larva on willow.

Maine and Massachusetts.

13. **S. purpurella** Hulst. Paler powdery gray, almost wholly suffused with light red, leaving a whitish band before the antemedial line, which is pale, heavily defined with blackish on both sides, toward inner margin, and erect; outer part of costa also without red; postmedial line obscure, indicated by the lack of red shading. 24 mm.

New Mexico, the Illinois record probably in error.

87. *IMMYRLA* Dyar

Similar to Salebria, with an antemedial scale tuft.

1. **I. nigrovittella** Dyar. Dark gray, median area slightly paler; ridge deep black, farther out toward costa, not reaching costa; antemedial line just beyond it and parallel, faint; postmedial line pale, faintly bowed at middle, dark-edged and running in a darker shade. 20 mm.

May and June.

Western Pennsylvania. New York: Ithaca.

88. *MYRLÆA* Ragonot

Similar to Laodamia; palpi shorter, fore wing much broader, with strongly arched costa.

1. **M. vetustella** Dyar. Light ash gray; head, collar, and base of fore wing Indian red, contrasting; antemedial line defined on the outer side with a blackish line; within, by a heavy blackish shade, the two fusing on the costa and obliterating the antemedial line. Discal dots gray, obliquely placed; postmedial line faint, emphasized by dark shades before it on the veins. 25 mm.

May.

Ithaca, New York, and south.

89. *LAODAMIA* Ragonot

(*Pinipestis*, in part)

Venation (fig. 380) and habitus practically as in the genus Dioryctria; Cu_2 o hind wing just about at one-third, discocellular vein separated by a distinct spac from lower side of cell, approaching it on a long slant. Male antennæ (fig. 390) and palpi about as in Salebria, but male palpi longer, and shaft of antennæ mor laminate than in our Salebrias; front rougher.

1. **L. fusca** Haworth. Blackish, lightly powdered with gray except on veins and lines; lines gray, normal, inconspicuous; antemedial zigzag. Discal dots large, black. 28 mm.

In variety **frigidella** Packard, the ground is gray, black only along the lines.

Locally common in July and August, especially on burnt-over heaths. The larva eats Vaccinium and willow.

Arctic America, south to Northern New Jersey and British Columbia. New York: Waterville, Rochester Junction, Ithaca.

90. *ELASMOPALPUS* Blanchard

Hind wing (fig. 383) with Cu_2 arising about a third way out on the wing, the discocellular vein well beyond it, and well separated from the lower side of the cell. Palpi as in Salebria, more oblique and straighter, with well-developed plume. Male antennæ strongly flattened, with hardly any notch, but a well-marked scale tuft not reaching the base of the shaft.

Key to the species

1. Fore wing with raised scales before the antemedial line; gray, with a blackish tuft ..... 1. *decoloralis.*
1. Fore wing smoothly scaled.
2. Markings distinct, normal, gray ..... 2. *petrellus.*
2. Markings strigose and broken; or obsolete; male light wood-brown; female dark ..... 3. *lignosellus.*

1. **E. decoloralis** Walker. Pale gray with a paler postmedial line; antemedial indicated by a few dots, with a small, slightly raised black patch before it toward the inner margin; black discal and terminal dots. 26 mm.

Not seen.

United States (Florida?)

2. **E. petrellus** Zeller. Head, thorax, base of fore wings, antemedial and subterminal spaces light wood-brown, the rest white, dusted and shaded with light dull gray, darker toward the inner margin; fold suffused with wood-brown in the median area; lines whitish, dentate, defined with dark gray dots, or broken dentate lines; discal dots partly confluent, darker gray, with some brown scales around them. Black terminal dots. ♂ 20 mm., ♀ 25 mm.

In variety **hapsella** Hulst the areas normally brown are only slightly browner than the rest.

New Jersey to Colorado, and south.

3. **E. lignosellus** Zeller. Male typically ochre yellow or light wood-brown, less rusty than the brown parts of the last species; costa and outer and inner margins normally shaded with fuscous brown, dusted with white, but sometimes concolorous; the borders disappearing at the base of the wing; ante- and postmedial lines of a few dots; only lower discal dot distinct, black; **Cu** sometimes narrowly shaded with powdery fuscous. Hind wing translucent white, with fuscous border. Typical female blackish, varying in details, and sometimes with a yellow bar on the disc. 15–25 mm.

The antenna is as in normal Salebria, with a large scale tuft, but the venation places the species here, and the palpi are even longer and more oblique than in *E. petrellus*.

The female variety **tartarella** Zeller is dwarf and wholly dark gray (*carbonella* Hulst). Female variety **incautella** Zeller is similar to the normal male. The amount of the whitish powdering on the fuscous border varies from practically none to a complete suffusion.

Southern States, south to Chili, straying north to Maine.

Pyla aëneoviridella Ragonot was described from New York in error; the type was from Wyoming.

91. *EPISCHNIA* Hübner

Palpi with stout oblique second segment; third segment long and porrect; maxillary palpi moderate, scaled; male antennæ, in our species, dentate, with a slight sinus at the base of the shaft. Fore wing exceptionally long and narrow, with normal venation, smooth; hind wing with discocellular closely parallel to lower side of cell from origin of Cu_2 to origin of Cu_1.

1. **E. boisduvaliella** Guenée. Fore wing typically pinkish ochreous, a little shaded with blackish and dusted with blackish along outer margin. Costa contrasting, white, from just beyond base to apex, the lower boundary practically straight and running through upper discal dot. Postmedial line usually indicated by a few blackish striæ; lower discal dot black; the other markings obsolete. 18–26 mm. (*farrella* Curtis, *lafauryella* Constant, etc.)

In variety **albocostalis** Hulst, the ground is dark fuscous, heavily dusted with white toward inner margin and apex, and the white costal stripe becomes diffuse and fades out at the apex.

Larva russet, with a greenish tint, and with obscure lateral reddish striæ; yellow-green beneath; in pods of Leguminosæ (Ononis, Anthyllis, Lotus, Astragalus), hibernating full-grown; moth in July.

New Hampshire and Massachusetts to British Columbia and Texas; Eurasia.

92. *ETIELLA* Zeller

Palpi with second joint very long, the lower side, and upper side except at extreme base, straight and regularly converging; third segment rather short, fine, and porrect; maxillary palpi with a plume, concealed in a groove in the second joint of the labials. Male antennæ hardly notched, with a heavy tuft of dark gray scales on inner side of shaft near base, and a tuft of finer pale hair scales on outer side, lying against it. Fore wing very narrow, with a slightly raised golden antemedial bar; hind wing ample, discocellular of type 3 (fig. 382) angulate at a point halfway between Cu_1 and Cu_2, then approximate to lower side of cell.

1. **E. zinckenella** Treitschke. Light gray, dusted heavily with light pinkish ochreous; a white costal stripe from base to apex, leaving the costal edge gray in the middle of the wing; antemedial band yellow, just beyond the deeper orange raised ridge; both cut off by the white costa. 18–25 mm. (*exiella* Treitschke, etc.).

Larva (fig. 394) in pods of Leguminosæ, sometimes injurious. Apple-green, reddish, or brown; tubercles yellow, with a black setigerous puncture; no enlarged one on mesothorax. Head amber yellow with a brown posterior line; prothorax green with three pairs of black dots, the lateral ones in a reddish shade.

World-wide, but rare in this country.

93. *MELITARA* Walker

(*Megaphycis* Grote)

Tongue short, weak, not always exposed between the bases of the palpi; antennæ not modified at base, pectinate in male, subpectinate in female; palpi massive,

porrect, the joints with separate short tufts on under side, that on the first th largest. Maxillary palpi large, flattened against the face. Fore wing rathe narrow, with short erect outer margin· venation normal; M_2 and M_3 stalked. Hin wing with Sc approximate to R; M_2 wanting; M_3 shortly stalked, discocellular o type 2 (meeting lower side of cell at 60 degrees; Cu_2 given off at two-fifths lengt of wing).

Very large species, the larva boring in the phyllodia of Cacti, and more or les social. Ours works in the prickly pear, Opuntia.

1. **M. prodenialis** Walker. Whitish, shaded with mouse gray, except toward th costa; antemedial line with outer component strong, blackish, with a long toot out on fold, the inner line faint, but traceable at the inner margin; postmedia line double, blackish, fading out below, strongly dentate except toward costa. A vertical black discal bar, and black terminal dots. 27–40 mm. Female larger.

End of July.

Southern New York to Florida and Texas; on the barrens northward.

94. *ZOPHODIA* Hübner

(*Pempelia,* in part; *Dakruma* Grote)

Front rounded out; antennæ nearly simple; tongue strong; palpi porrect thickly and evenly scaled; more oblique in female. Maxillary palpi simple; vena tion about like that of Melitara; the fore wing narrower, with more oblique outer margin.

1. **Z. grossulariæ** Riley. Brownish gray, whitish toward costa; antemedial lin erect, dentate, forming a W; postmedial line oblique and nearly straight to M_2, then dentate to inner margin. Wing more or less striate, especially toward base Male much less contrastingly marked than female. 25 mm. (*turbatella* Grote.) (H. p. 411 f. 230.)

Larva injurious to currants and gooseberries, feeding on the berries and webbing them together.

Canada and Maine to Illinois. New York: Lancaster (VanDuzee).

2. **Z. bella** Hulst. Similar to *Z. grossulariæ*, powdery pale gray; more strigose; antemedial line represented by a diffuse dark shade, running out at middle and on inner margin; postmedial line strongly oblique with a single large tooth at M_2. 28 mm.

Massachusetts.

Typically the two lines of the postmedial line are about equal, but the inner is much stronger in the Colorado form.

95. *EUZOPHERA* Zeller

Palpi erect, second joint scaled, third erect and acuminate; maxillary palpi broad-scaled and appressed to front. Fore wing (fig. 384) with arched costa and rounded apex, Cu_1 well separated, M_2 and M_3 long-stalked; R_2 rarely stalked. Hind wing with Sc strongly anastomosing with R, discocellular vein moderately curved; M_2 stalked or connate with Cu_1.

Key to the species

1. Lines represented by blackish dots ..... 5. *inornatella.*
1. Lines, at least the postmedial one, clear and continuous.
   2. First line well before middle of wing; nearly straight and vertical, almost obsolete ..... 1. *franconiella.*
   2. First line close to middle of wing, distinct, pale; the wing reddish before it.
      3. Median area broadly fuscous, shaded with red; 28 mm.... 2. *ostricolorella.*
      3. Median area crisply dusted with black on white; 22 mm.. 4. *semifuneralis.*
      3. Median area blackish, or suffused with red-brown; 12 mm. 3. *ochrifrontella*

1. **E. franconiella** Hulst. Light gray, strigose, dusted, and shaded on a white base, the costa paler; antemedial line obscure; discal spot rather H-shaped (turned on its side), postmedial line oblique, obscure, and coarsely toothed; terminal dots blackish, a little diffuse. 25 mm.

Franconia, New Hampshire.

2. **E. ostricolorella** Hulst. Dark gray, suffused with dull Indian red; the base mostly reddish; antemedial line at middle of wing; diffuse, pale, nearly even, a little bent out at inner margin; postmedial line rather beyond three-fourths, more erect than outer margin, pale and diffuse, somewhat toothed opposite lower angle of cell; terminal line blackish, almost continuous, discal spot obscure. 28 mm.

Larva mining in the bark of the trunk of tulip tree, usually near the ground, and only where the bark is damp; maturing in the spring. Moth from May to July.

New York (Hulst). Was described from the State. Type only seen.

3. **E. ochrifrontella** Zeller. Fuscous gray, the lines luteous or indicated by white powdering; ground a little powdery at end of cell and along outer margin; base and sometimes median area suffused with reddish. Antemedial line broadened and more diffuse; postmedial line clearer, a little wavy, a little more oblique than in *E. ostricolorella*. 12 mm.

May; July and August.

New York to Iowa. New York: Ithaca.

4. **E. semifuneralis** Walker. Median area blackish, sometimes dusted or mottled on a white ground. Basal half and outer margin light reddish gray, heavily dusted with white, especially along the outer margin and on the costal half of the base. Lines white, powdery, wavy, normal, the antemedial line near the middle of the wing. 20–25 mm. (*pallulella* Hulst, *impletella* Zeller).

Larva under bark of peach and plum; sometimes injurious.

Massachusetts to Colorado and south. New York: Lancaster (VanDuzee), Kinderhook.

5. **E. inornatella** Hulst. White, lightly dusted with gray; two or three blackish dots at middle of wing representing the antemedial line, and four or five the postmedial line; two discal dots. 20 mm.

May.

Anglesea, New Jersey.

96. *VITULA* Ragonot

Similar to Euzophera. Front tufted; wings of male with a tuft of scales at base of costa below; M_2 and M_3 stalked; hind wing with cell short; discocellular vein not much curved; M_{2+3} and Cu_1 connate or nearly so; Cu_2 at one third the length of the wing.

1. **V. edmandsii** Packard. Gray, powdery, somewhat shaded with brownish; first line well toward middle of wing, oblique, a little wavy, diffuse, broad and blackish; postmedial line at four-fifths way to apex, paler, defined with fuscous, diffuse, a little irregular, and angled opposite lower angle of cell; a dark discal bar. 20 mm.

June to October. Larva (fig. 395) in bumblebee nests.

Generally distributed. New York: Buffalo, Ithaca.

97. *LÆTILIA* Ragonot

(*Dakruma* Comstock)

Tongue weak; labial palpi oblique, reaching about to vertex; maxillary palpi normal; front smooth; male antennæ ciliate; fore wing smooth, with R_2 free, M_2 and M_3 stalked, Cu_1 from angle of cell; hind wing with discocellular moderately curved, Cu_2 arising from near angle of cell; M_2 and M_3 and Cu_1 long-stalked; Sc and R fused to very near apex.

Larva feeding on soft scales (*Pulvinaria*) on Negundo and other trees, spinning a light silken tube not unlike that of Feniseca.

1. **L. coccidivora** Comstock. Light gray, heavily shaded with white on costa and outer margin; antemedial line white, narrow, erect, and a little excurved with a fine gray line before and a heavy shade behind it; postmedial line a little waved, fine toward costa, heavily defined with blackish, becoming broader and defined with broader shades of light fuscous toward inner margin. Discal dots often fused, black; terminal dots black. 15–18 mm.

General southward. New York: Albany.

2. **L. myersella** Dyar. Similar to *L. coccidivora*, but without gray suffusion on the inner half of the fore wing, the white reaching the inner margin. Lines clean-cut and heavily gray-edged, the antemedial more waved than in *L. coccidivora*.

September.

Southern Pines, North Carolina.

L. fiskella Dyar, from Pennsylvania and North Carolina, is unknown to me.

98. *CANARSIA* Hulst

Tongue strong; palpi with second joint reaching vertex and third slender; maxillary palpi normal; front tufted; male antennæ compressed, with sinus and strong scale tuft at base of shaft. Fore wing (fig. 385) normal; Cu_1 from angle of cell, M_2 and M_3 stalked; hind wings with Cu_2 a little before angle of cell; discocellular as in Lætilia; Sc anastomosing with R.

1. **C. ulmiarrosorella** Clemens. Fuscous gray, more or less dusted with white, especially on the disc and outer margin. Lines double, darker gray, filled with whitish; antemedial lines well out, wavy, postmedial line somewhat wavy and irregular; the outer line of the antemedial often blackish, clean-cut and contrasting; a whitish patch or shade beyond it on inner margin. Fine separate terminal dots; discal bar high and narrow. 13–16 mm. (*pneumatella* Hulst, *ulmella* Ragonot, *fuscatella* Hulst).

End of June to August. Larva green with paler dorsal and stigmatal lines; several segments with brown subdorsal dots; head pale brown with darker stains; found on elm and, rarely, on hickory in a silk nest between leaves, in August.

Canada to Texas. New York: Peru, North Creek, Otto, Ithaca, New Windsor.

2. **C. gracilella** Hulst. Similar to *C. ulmiarrosorella;* paler, the markings slightly more obscure.

The types from northern New Jersey, appear to be merely somewhat pale and rubbed specimens of *C. ulmiarrosorella.*

99. *PSOROSINA* Dyar

Fore wing with M_2 and M_3 separate; hind wing with Cu_2 at angle of cell, M_2 and Cu_1 stalked. Male antennæ bent, with a tuft in the bend as in the last genus; tongue moderate; palpi upturned to vertex; maxillary palpi filiform.

1. **P. hammondi** Riley. Wings very broad, brown-black with some white scales, the two usual lines nearly erect, fairly even and of white powdering, the postmedial fading out at the costa, where there is a powdery white patch before it. 12 mm. (Canarsia auct.)

Larva dull green or brown, with black tubercles; head pale with greenish face, cervical shield black; feeding on pear, and also bred by Miss Murtfeldt from an acorn.

2. **P. angulella** Dyar is unknown to me. It is described as practically like *P. hammondi,* but with an angulate antemedial line.

Iowa.

100. *VALDIVIA* Ragonot

(*Maricopa* Hulst)

alpi long, porrect, second joint bowed above, maxillary palpi invisible. Tongue eloped. Wings sublanceolate, fore wing with R_2 arising from cell, M_2 and M_3 -stalked Cu_2 from angle of cell.

V. albocostella Hulst. Palpi blackish. Fore wing with anterior third whitish, a vinous tint, somewhat mixed with dark scales, the rest fuscous, vinous ard inner margin; large black discal dots. Hind wing fuscous, paler at base; nm.

ugust. Unknown to me.
nglesea, New Jersey.

101. *HULSTIA* Ragonot

alpi as in Canarsia. Front smooth, antennæ normal. Cu_1 and Cu_2 of fore g arched, from very near end of cell; M_2 and M_3 stalked, on a line with base of hind wing with Cu_2 from angle of cell; M_1 stalked; Sc and R anastomosing; M_2 lked with Cu_1. In one specimen before me M_3 is preserved, long-stalked with

. **H. undulatella** Clemens. Brownish ash gray, a little shaded with light brown, l powdery; ground sometimes mixed with yellow-brown; antemedial line white, , wavy and outwardly oblique, the fine dark gray line on its outer side thick- d at costa; antemedial space broadly mouse gray, especially toward inner rgin where it is preceded by some white scales. Postmedial line wavy and egular, fine, pale, with a sharp dark gray line on inner side, and a more or less tinct broad, gray subterminal shade on its outer side. Discal dots confluent into ar; terminal dots fine. Postmedial line not distinctly bowed at the middle. -20 mm.

July and August; not rare locally.
Quebec to California. New York: Niagara Falls, Kinderhook.

102. *HONORA* Grote

Palpi oblique to above vertex; second segment slender and evenly scaled, third rrect and rather large. Maxillary palpi short and thickened with scales at tip. tennæ simple. Wings narrow; venation as in Hulstia.

1. **H. fumosella** Hulst. Dull black, shaded with ochre yellow between the veins. nes fine, white, a little diffuse under a lens. Basal line distinct, at one-sixth y out, incomplete. Antemedial line from costa at one-third to middle of inner rgin, nearly straight; postmedial line well out, nearly straight, and distinct ward the inner margin only; erect. 15 mm.

July. Type only seen.
Newark, New Jersey.

103. *DIVIANA* Ragonot

Palpi slender, recurved, second segment tufted in front; maxillary palpi fusi- rm; antennæ a little curved at base of shaft in male, with teeth in the sinus. re wing with M_3 wanting, R_2 free, M_2 and Cu_1 from angle of cell; hind wing with ll moderate, Cu_2 arising near angle, M_2 stalked; M_1 stalked, Sc and R astomosing.

1. **D. eudoreella** Ragonot, a brownish gray species, with fairly normal markings, curs from North Carolina to Florida.

104. *HOMŒOSOMA* Curtis

Palpi obliquely upturned to level of vertex, or, rarely, shorter and rough-s maxillary palpi slender, normal; male antennæ rather thick. Fore wing wi free, R_3 wanting as well as R_4, M_2 and M_3 stalked or united, Cu_1 and Cu_2 ap mate and strongly curved; hind wing with discocellular vein straight (fig. a little flattened and widened, normally not tubular, Sc anastomosing sti with R, its tip often very short; M_1 normally shortly stalked, M_2 and M_3 u Cu_1 from cell. (Larva, fig. 396.)

Key to the species

1. Antemedial line indicated by two or three black dots (on R, Cu, and A) 1. *electe*
1. Antemedial line distinct, sometimes interrupted.
2. Antemedial line practically straight and vertical.....2. *stypticel*
2. Antemedial line sharply angulate.....3. *mucidellum, reliquel*

1. **H. electellum** Hulst. Powdery light gray, with a white subcostal streak; represented by a few darker dots, or obsolete, the antemedial dots in a ver series when distinct; at least one dark discal dot present, sometimes both. To nal dots dark, often obscure. 15–22 mm.

July and August. Larva on buds of Grindelia and in seeds of sunflower. L with purple dorsal, subdorsal, and substigmatal lines, twice as wide as the s between them. Pale below; head light brown, with dark lateral band from of head to eyes.

Southern New Jersey; Iowa, and west.

2. **H. stypticellum** Grote. White, more or less dusted and shaded with g Antemedial line white, obscure, erect, followed by a heavy dark gray shade; medial line oblique, parallel to outer margin, diffuse but distinct, with a st transverse dark gray shade between it and the end of the cell; discal dots black Hind wing gray. 20 mm.

June and July. Larva apparently in the panicles of *Rhus glabra.*

Maine and northern Ontario to Costa Rica. New York: Fentons, Ithaca.

H. anguliferellum Ragonot, an Indian species recorded from North America, p ably in error, is similar to *H. stypticellum*, but with the antemedial shade sha angled and the discal points well separated. 30 mm.

3. **H. mucidellum** Ragonot. Pale powdery gray; antemedial line dark g strongly and acutely angled at middle; or represented by three dark gray d the middle one much farther out than the other two; postmedial line pale, defi with gray shades, parallel to outer margin. Discal dots distinct, sometimes fus Hind wing translucent whitish, with darker veins. 20 mm.

July; September. Larva in heads of Gnaphalium and apparently in chicory s New York to Florida and west. New York: Ithaca.

H. reliquellum Dyar, from New Hampshire, appears to be a variety of *H. mu dellum;* it has a somewhat less angulate antemedial line, and rather darker h wing.

105. *EPHESTIA* Guenée

Palpi upturned beyond vertex, third segment long; maxillary palpi norma antennæ, in our species, simple laminate. Fore wing with R_2 from cell; R_3 and wanting, M_2 and Cu, from angle of cell, Cu_2 arising well before angle. Hind wi with cell short; with middle discocellular short, but decidedly curved, Sc with very short free tip, R shortly stalked. Wings sometimes tufted.

The larvæ are pests in dried-food products. The four species noted below ha been introduced here and there, from Europe, but *E. kuehniella* has become ve common.

Key to the species

Hind wing with cell short, M_2 free from the angle; Sc rudimentary; fore wing with postmedial line sinuous, oblique.
2. Antemedial line angulate or dentate; a black discal lunule or point.
1. *kuehniella.*

2. Antemedial line very slightly angulate or dentate, or even.
3. Antemedial line oblique from costa to **Cu**, then erect to inner margin.
3. *figuliella.*

3. Antemedial line vertical.....2. *cautella.*
Cell long, M_2 stalked with Cu_1.....4. *elutella.*

E. kuehniella Zeller (Mediterranean flour moth). Typically even pale or h gray; lines paler, outlined with darker, often faint; antemedial line zig- postmedial dentate; a slightly darker discal lunule. Hind wing mostly slucent white. 22 mm. (**H** p. 412, f. 232–233.)
rva white to red, with yellow-brown head; usually in meal, and showing a led preference for rolled wheat.
nerally distributed and rather common; sometimes in injurious numbers. New :: Ithaca.
ere are several inheritable mutations of this species, the most striking being ck one, and one with blackish ante- and postmedial bands.[38]

E. cautella Walker. Brownish or blackish gray; similar to *E. kuehniella* pt for the direct, rather distinct, pale antemedial line; defined with dark he outer side. 15–20 mm. (**H.** p. 414, f. 235.)
rva with contrasting black tubercles; white, with amber head; commonest ried figs.
ew York: Albany.

E. figuliella Gregson. Antemedial line oblique from costa to Cu_1, then up- t to inner margin. Dark gray, similar to the last two species. 20 mm.
rva with dark brown head, cervical shield, and tubercles. Injurious to dried t.

E. elutella Hübner. Blackish to light gray-brown, tinted with ochreous and ish. Lines formed of white powdering, moderately wavy; antemedial line at dle of wing; often obsolete. 15 mm.
arva light flesh color, with red-brown head, cervical shield, and supra-anal e, and small brown tubercles; found in rotten wood.
ew Jersey, western Pennsylvania, etc. Europe. Probably native. New York: any.

106. *EPHESTIODES* Ragonot

alpi upturned to vertex, third segment longer than second, broadly scaled; ennæ simple; maxillary palpi normal. Fore wing with 10 veins; M_2 and M_3 ked. Hind wing with Sc minute, M_2 and Cu_1 long-stalked; Cu_2 from angle of

E. infimella Ragonot. Wings narrow, reddish luteous, yellower at the base, shaded with violet gray in the middle above the fold. Antemedial line dif- , nearly erect, obscure, followed by a blackish shade. Postmedial line oblique, eded by a dark shade; discal points distinct, sometimes fused. Terminal ce decidedly reddish. 10 mm.
une in the North, earlier in the South. Larva in seeds of Ambrosia.
irginia to Texas and California; North Carolina; Columbia. New York: aca (?)

[38] Details have been published by P. W. Whiting in the *Journal of Experimental Zoology* 28: 413. 1919

107. *MOODNA* Hulst

(*Manhatta* Hulst; *Hornigia* Ragonot)

Palpi in our species oblique, beak-like, with third segment almost as lo
second; antennæ typically a little sinuous toward base. Fore wing (fig.
narrow, with a costal fold and hair pencil on under side in male. R_2 free, R_3
M_2 and M_3 stalked; Cu_1 arising from angle of cell, and Cu_2 well before it.
wing with M_3 wanting, M_2 and Cu_1 connate or short-stalked; discocellular s
curved; Cu_2 arising well before angle. The larva of the type species (in Eu
feeds on pine.

1. **M. ostrinella** Clemens. Male antennæ with very slight sinus. Fore
crimson, sometimes suffused with gray; median area shaded gray, suffused
black, except beyond the discal dots; lines well marked, pale; antemedial
well out, postmedial slightly waved. 15 mm. (*obtusangulella* Ragonot.)

Larva in sumac heads (Crosby) and in acorns (Murtfeldt). Moth in
July and August.

Pennsylvania; Texas. New York: Rochester, Otto, Ithaca.

2. **M. pelviculella** Hulst. Gray, much lighter than *M. ostrinella;* base wa
with russet; antemedial line erect; pale, followed by a darker shade; c
weaker, denticulate. 15 mm.

Pennsylvania; doubtfully distinct from *M. ostrinella.*

108. *PLODIA* Guenée

Front strongly tufted; palpi beak-like, porrect, about as long as head; ante
simple; male with a small costal fold and pencil on fore wing. Fore wing
387) with R_3 and M_3 lost, Cu_1 separate, Cu_2 arising well before angle of cell. H
wing with Sc free only at extreme tip; R short-stalked, discocellular oblique,
wanting and Cu_2 arising well before angle of cell.

1. **P. interpunctella** Hübner. Base clay color, greenish when fresh; outer th
fifths dull red-brown, contrasting with three or four shining lead-gray ba
the last one terminal. 15 mm.

Larva injurious to stored grain, and occasionally on other dried foods;
yellow with russet head and shields. (H p. 415 f. 236.)

Generally distributed and world-wide. New York: Common generally.

109. *CAUDELLIA* Dyar

Fore wing with only nine veins; R_4 and M_2 lost, M_3 and Cu_1 arising separat
Hind wing with seven veins; Sc very short, M_3 and Cu_1 separate; cell half
long as wing. Tongue well developed, palpi oblique, projecting twice the len
of head, third segment deflexed, maxillary palpi filiform. Ocelli present. M
antennæ with a slight flexure on shaft. Fore wing with an oblique scale tuft
under side of costa near base.

1. **C. apyrella** Dyar. Dark vinous brown, heavily shaded with black. Ma
obscure, of vinous shades. Antemedial line a vague paler shade; an obsc
light postmedial patch, reaching up to the discal dot; a black shade at ap
and terminal line. Costal tuft vinous. Hind wing translucent whitish, shad
with fuscous. 14–15 mm.

June and July.

Plummer's Island, Maryland.

2. **C. albovittella** Dyar. Third segment of palpus shorter; a costal fold
male besides the tuft. Fore wing vinous brown, shaded with black. Antemedi
line white, oblique, straight, almost forming a blotch subcostally; postmedi

ish, well out; discal dots small, black, followed by white scales. Hind wing
C. apyrella. 13 mm.
ly.
ummer's Island, Maryland.

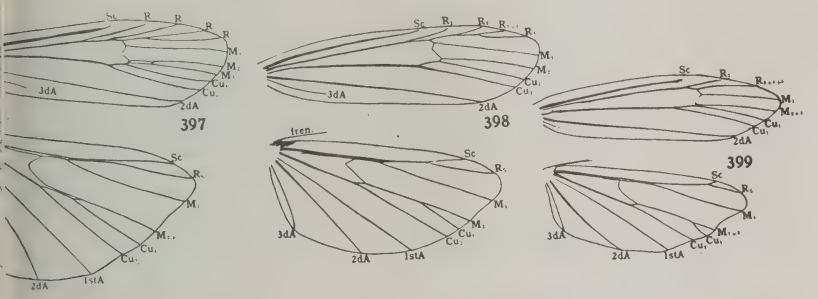
Subfamily ANERASTIINÆ

(Peorinæ; Phycitinæ, in part)

osely similar to the Phycitinæ, and hardly worth separating; more frequently
porrect palpi and dominantly longitudinal markings. Ocelli present in our
ies. Tongue weak, not separating the palpi.
ere are a couple of genera which seem to be closely related to the normal
citinæ but with a weak tongue. They are taken up with the Phycitinæ, but
ded in both keys to genera, for convenience.

Key to the genera

Cu of hind wing apparently trifid (one medial lost).
2. Cu of fore wing quadrifid (M_2 preserved).
3. Palpi upturned to vertex.....(**Lætilia**-Phycitinæ).
3. Palpi porrect and beak-like.
4. R_2 stalked, M_2 and M_3 stalked or connate; hind wing with Sc and R anastomosing .....110. **Aurora.**



FIGS. 397–399. ANERASTIINÆ

397, *Pectinigeria gemmatella,* venation (The cross-vein between M_2 and M_3 is probably an individual aberration.); **398,** *Peoria hæmatella,* venation; **399,** *Tampa mediatella,* venation

4. R_2 generally free; hind wing with Sc and R approximate.
5. Male antennæ pectinate.....(**Melitara**-Phycitinæ).
5. Male antennæ laminate and grooved at base
6. Maxillary palpi with a small plume.....111. **Poujadia.**
6. Maxillary palpi simple.....112. **Pectinigeria.**
2. Cu of fore wing trifid (M_2 lost).
3. M_3 and Cu_1 separate; palpi porrect.....113. **Peoria.**
3. M_3 and Cu_1 stalked; palpi upturned.....116. **Varneria.**
. Cu of hind wing trifid.
2. R_2 stalked, M_2 stalked, Cu_1 and Cu_2 of fore wing free.....114. **Calera.**
2. Cu_1 and Cu_2 stalked; fore wing with nine veins only.....115. **Cabnia.**

110. *AURORA* Ragonot

Similar to Peoria. Palpi as long as head and thorax; maxillary palpi normal; fore wing with 11 veins, R_2 stalked, M_2 and M_3 stalked, Cu_1 from a cell. Hind wing with short cell; Sc and R anastomosing, M_1 stalked, M_2 a long-stalked, Cu_2 arising before angle of cell.

1. **A. longipalpella** Ragonot. Gray, with a whitish shade toward costa; medial line shaded with blackish, running obliquely up and in from inner toward costa; outer line similar; below, nearly parallel to outer margin, toward costa; no discal points. 22 mm.

October.

"North America" (Ragonot), perhaps western.

111. *POUJADIA* Ragonot

Palpi oblique, third segment porrect, second with a cavity containing the maxillary plume. Front with a conical tuft. Antennæ with a sinus and a scale tuft. Fore wing with R_2 free, R_3 and R_5 stalked, M_2 and M_3 stalked, Cu_1 angle of cell. Hind wing with Sc free, R and M_1 connate, M_2 and Cu_1 stalke lost, and Cu_2 well back from angle of cell.

1. **P. glareosella** Zeller. Dull, somewhat pinkish gray, with a darker below the whitish costa toward the base; costa diffusely white to the discal bar faint, darker. Hind wing pale and translucent. 18 mm.

August.

East River, Connecticut, to Texas.

112. *PECTINIGERIA* Ragonot

(*Cayuga* Hulst; *Spermatophthora,* in part)

Palpi very long, porrect; maxillary palpi small, normal; tongue weaker in Melitara; ocelli distinct. Male antennæ broadly laminate below, with a l tudinal groove in the base of the shaft above, flanked by scale ridges; basal ments of shaft partly fused. Fore wing (fig. 397) with 11 veins, R_2 cl approximate (sometimes partially fused) to stem of R_{3-5}, M_2 and M_3 stalked, arising well before angle of cell; hind wing with M_2 lost; Cu_2 distinct from a of cell; M_2 and Cu_1 stalked; Sc and R closely approximate or partly fused.

1. **P. gemmatella** Hulst. Pinkish, about the color of *Peoria approximatella,* strigose; costal stripe paler pink, streaked with white on Sc and R, with a bl ish shade below it running along lower side of R to end of cell and then to a 25 mm.

Coast of Massachusetts and New Jersey; Illinois and west.

113. *PEORIA* Ragonot

(*Eurhodope, Anerastia,* in part)

Male antennæ slightly curved at base of shaft, only slightly laminate; p porrect, long, and pointed; maxillary palpi very small. Fore wing (fig. 3 with 10 veins: R_2 stalked. M_2 and Cu_1 connate, Cu_2 arising near angle of Hind wing with Sc and R anastomosing; M_2 and Cu_1 long-stalked.

1. **P. approximella** Walker. Fore wing dull rose to deep purple, shading brown on cell, and pale below; costa contrasting, white; the stripe covering p of the cell at the base, and running to apex, shaded below with blackish. 20 m (*hæmatica* Zeller, *roseatella* Packard).

June and early July.

ommon and generally distributed. New York: Peru, Lancaster, Ithaca, Big an Valley, Rhinebeck, New Windsor, Katonah.

P. bipunctella Ragonot. Similar, with costal half of fore wing white, includ- the cell; ground generally paler. 15 mm.

rth Carolina.

114. *CALERA* Ragonot

milar to Peoria; scape broadened and flattened; M_2, M_3, and Cu_1 fused.

C. punctilimbella Ragonot. Marked like *P. approximella;* more delicate, rule without any blackish shade. Very possibly a venational aberration of *oximella.*

rth Carolina; Texas; Louisana.

115. *CABNIA* Dyar

re wing with Cu_1 and Cu_2 stalked, M_2 absent, as well as M_3; three radials ; a costal fold beneath, at base. Palpi upturned, second segment with a tuft w; maxillary palpi simple; male antennæ with a slight process on scape; t sinuous at base and slightly thickened, with a few hairs in the bend.

C. myronella Dyar. Dark cinereous, even; lightly dusted with white; lines ure, whitish, sinuous, distinct only toward the inner margin. 11 mm.

ne.

istrict of Columbia.

116. *VARNERIA* Dyar

ore wing with nine veins; R_2 and R_4 separate, M_2 lost, M_3 and Cu_1 stalked; il wing with six veins, Sc and M_2 lost, M_3 and Cu_1 stalked; Cu_2 near angle; ocellular short, slightly curved. Tongue as long as head; palpi upturned lve vertex, third segment more than half as long as second.

V. postremella Dyar. Crimson, immaculate. Head, thorax, and costa of fore g somewhat suffused with blackish; sometimes with blackish shades on the ns beyond the cell. Hind wing fuscous gray. 10 mm.

uly and early August.

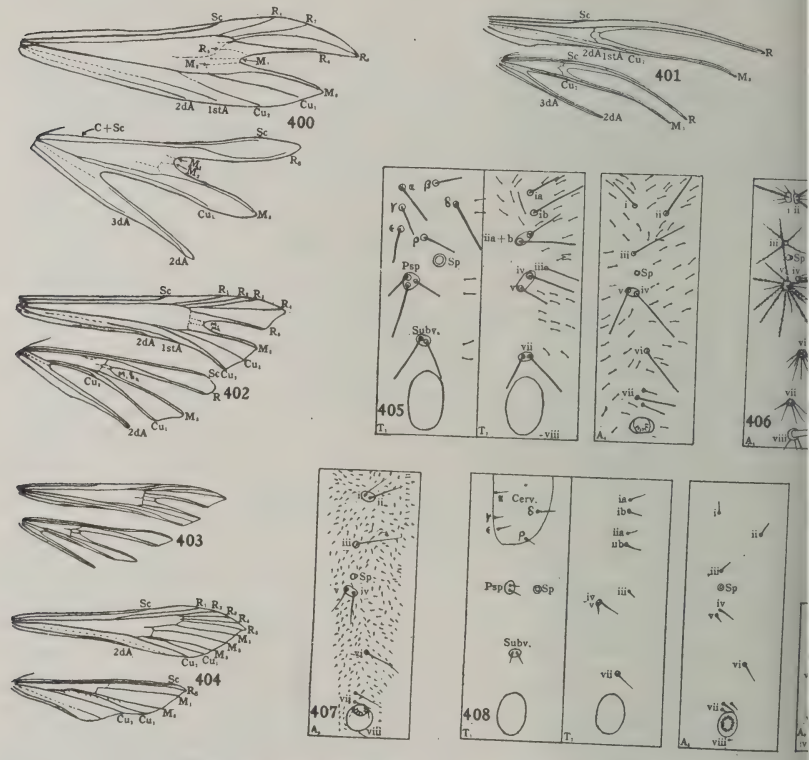
ast River, Connecticut, to Kentucky.

Family 34. PTEROPHORIDÆ

(Alucitidæ)

Head prominent; palpi often rather long, tongue functional; maxil- y palpi obsolete; ocelli weak or absent; antennæ long, with two vs of scales to a segment above; pubescent below, simple. Legs very g and slender, the hind legs normally much longer than the entire ly; with strong scale tufts at the spurs; spurs all present and excep- nally long. Fore wing, in the northeastern species, deeply cleft at ddle of outer margin; hind wing cleft into three narrow feathers, en nearly to the base (in the Agdistinæ (fig. 404) the wings are tire). Venation of fore wing (figs. 400 to 403) often reduced in the lial region, M_1 and M_2 very short and weak, running to the notch, t **A** generally well developed, much longer than **2d A**, anal angle ated if developed at all, at Cu_2. Inner margin of fore wing and sta of hind wing folded over near middle and interlocking. Hind

wing with **Sc** and **R** closely parallel to beyond the end of the then diverging and supporting the first feather; $\mathbf{M}_1$ and $\mathbf{M}_2$ the fore wing, $\mathbf{M}_3$ and $\mathbf{Cu}_1$ supporting the second feather, $\mathbf{Cu}_2$ cl parallel to $\mathbf{Cu}_1$ but much shorter, often fading out, the two marked by a groove on the under side of the wing and beari double series of dark spatulate scales, which is the surest chara istic of the family. One or two developed anals, supporting last feather, which often bears tufts of dark-colored scales in fringe.



FIGS. 400–408. PTEROPHORIDÆ AND ORNEODIDÆ

400, *Pterophorus elliottii*, venation; **401**, *Alucita pentadactyla* (Europe), ve tion; **402**, *Platyptilia cosmodactyla*, venation; **403**, *Stenoptilia pelidnodact* (Europe), venation; **404**, *Agdistis statices* (Europe), venation; **405**, *Platypti rhododactyla*, seta map of larva; **406**, *Pterophorus lienigianus* (Europe), seta m of a middle segment of abdomen; **407**, *Oxyptilus hieracii* (Europe), seta map of middle segment of abdomen; **408**, seta map of larva of *Orneodes hexadactyla*

The moths rest with the fore wings folded, enclosing the hind wings in a tight roll, the whole held at a sharp angle, often at right angles, to the body. The flight is very weak and suggests that of a crane fly.

Egg of flat type. Caterpillar (fig. 405–407) with prolegs slender, often almost stalked, with a few hooks in a single band; the hair often glandular; usually with secondary or tufted hair; warts **iv** and **v**, as well as **i** and **ii** tending to unite, but quite variable. Spiracles small and circular, unlike the Macrolepidoptera. They are mostly leaf rollers, a few are borers.

Pupa usually suspended by the tail, but of the incomplete type in the number of free segments; maxillary palpi absent; fore and mid-legs extending between eyes and antennæ; never with a deep groove between ninth and tenth segments of abdomen; rough or with tufted setæ, often very angular. Cremaster elongated, covering a ventral strip on last three segments, or divided in two.

The Pterophoridæ are an isolated group, but evidently nearest to the Pyralididæ; over 350 species are known.

The northeastern genera represent two tribes. In the Platyptiliini there are almost always specialized scales in the fringe; the second feather of the hind wing contains three veins (save in Trichoptilus); the head usually bears bifid scales, and the female frenulum is usually simple. The larva almost always has secondary hair. The Pterophorini never have specialized scales in the fringe, there are only two veins in the second feather, the head rarely bears bifid scales, and the female frenulum is usually of two bristles.

In this family the revision by Barnes and Lindsey has been followed in the delimiting of genera and species, but it has seemed better to leave the more familiar generic names undisturbed, retiring the two oldest, Pterophorus and Alucita, temporarily, as of uncertain application. If Hübner's "Tentamen" is taken at face value as a real attempt to define a series of genera by fixing types, Pterophorus would fall to a group not known from the northeastern States, in any case. The key to Oidæmatophorus is based primarily on Barnes and Lindsey's key. New York records in some cases are few on account of the impossibility of verifying records at present.

Key to the genera

1. Hind wing with a black scale tuft in third feather.
2. Fore wing with marked anal angle; second feather truncate.
3. First feather of fore wing also truncate, with marked anal angle; R_1 and R_2 both free (fig. 402) ..... 1. **Platyptilia.**
3. First feather lanceolate; R_1 only free ..... 2. **Oxyptilus.**
2. Both feathers linear ..... 3. **Trichoptilus.**

1. Hind wing without any black scaling on third feather:
2. First lobe of hind wing lanceolate; one radial missing, there being only veins in the first feather (fig. 400).
3. Fore wing with contrasting black scale tufts in dorsal fringe; C hind wing preserved.....5. **Marasma**
3. Fore wing with dorsal fringe of fine hair only; Cu_2 of hind wing l
4. Fore wing with all four radials free.....6. **Oidæmatoph**
4. Fore wing with R_2 and R_4 stalked.....7. **Ad**
2. First lobe of hind wing obliquely truncate; fore wing with all veins served (M_1 and M_2 rudimentary, as usual).
3. Front conical (in our species); fore wings narrower.....4. **Stenop**
3. Front flat, with a tuft of scales only, fore wings broader (fig. 402) 1. **Platyp**

1. *PLATYPTILIA* Hübner

(*Amblyptilia* Hübner, *Cnæmidophorus*, *Eucnæmidophorus* Walleng *Sochchora* Walker, *Gilbertia*, *Crocidoscelus* Walsingham, *Gillm Fredericina* Tutt)

Fore wing only moderately cleft (fig. 402); both feathers broadening obliquely truncate apices, and quite broad; front more or less tufted, but wit a horny cone; palpi fairly long and oblique. Tibiæ normally tufted, smoot *P. punctidactyla*. The black scaling on the third feather is variable from sp to species, and is useful for distinguishing the species; it is rarely absent.

The larvæ (fig. 405) are borers, at least when young, and have simple prin and fine secondary hair, or hair-like granulations. They hibernate part-grow

Key to the species

1. Basal portion (more than half) of third feather of hind wing white, trasting with the rest of the wing; fore wing bright ochre..9. *rhododact*
1. Third feather concolorous, sometimes with pale fringe; fore wing duller.
2. Ground clay color to tawny.
3. Tuft conspicuous, dark, a chocolate brown costal triangle on fore w 6. *carduidact*
3. Tuft weak or absent, no costal triangle on fore wing, but an oblique sh only; frontal tuft and palpi very long.
4. Tuft rather diffuse, at middle of third feather.....1. *pallidact*
4. Tuft near apex of third feather, sometimes absent.....2. *carol*
2. Ground gray to chocolate brown.
3. Tuft three-fourths way out on third feather.
4. Grayish with conspicuous dark markings; tuft oblong, with sc all of about equal length.....3. *edward*
4. Dark gray, with markings scarcely darker; tuft triangular. 4. *aur*
3. Tuft at middle of feather.
4. Tuft inconspicuous, of scales both before and beyond middle of feath 5. *tesseradact*
4. Tuft conspicuous and triangular, beginning at middle of feather.
5. Fore wing shaded subterminally with wood-brown..8. *acanthodact*
5. Fore wing all black, gray, and white.....7. *punctidact*

1. *Tuft on inner margin very slight, brown, near middle of third feath palpi and frontal tuft very long* (Gillmeria).

1. **P. pallidactyla** Haworth. Head, body, and fore wings clay color or p ochre yellow; fore wing more or less shaded and banded with ochre-brown, r

forming a costal triangle, but usually a distinct marginal band. Hind wing dark yellowish fuscous, the tuft light brown and variable in distinctness. Hind tibiæ white at base, dull brown outwardly; metatarsi brown-tipped. 22 mm. (*marginidactyla* Haworth.)

Common in June, flying into July. The caterpillar bores in the stems of yarrow, in the fall, hibernates when half-grown, and feeds more or less exposed in the crown of the plant, in the spring. It is green, with three pairs of white stripes, the subdorsal being the strongest. When half-grown, it has purple-brown stripes. The secondary hairs (or possibly enlarged skin-granulations) are minute; the primaries simple, iv and v separate, vi of two setæ. It is also reported on leaves of Senecio.

Generally distributed. New York: Peru, Newcomb, North Creek, Black Brook, vicinity of Buffalo, Rock City and Vandalia (Cattaraugus County), Potter Swamp (Yates County), Portage, Ithaca, Karner, Albany.

II. *Hind wing with a small tuft more than three-quarters way out, rarely absent; and no distinct one at apex; fore wing with scattered black marginal scales, but no tuft; head as before. Larva unknown.*

2. **P. carolina** Kearfott. Frontal tuft and palpi long. Ochre yellow, fore wing with a little darker dusting; costa dusted with black from one-third to three-fourths way out; dark dots below costa at one-third and on lower lobe just before the cleft. Terminal line blackish brown. A lighter brown line in base of fringe, the rest of the fringe slightly purplish. Dark specimens with the usual pattern of the genus in brown. Hind wing slightly pinker, with tuft very small or absent. Legs nearly concolorous. 18–26 mm.

End of May to September.

New Jersey; Valley of Black Mountains, North Carolina; Utah; California.

3. **P. edwardsii** Fish. Tawny red-brown, costa blackish on basal two-thirds; triangle black-brown, followed by a white streak and a white bar in the costal fringe. Subterminal line white, with a blackish shade before it, preceded by dark streaks or shades on the costa and at the middle of the first lobe. Fringes black and white. Hind wing red-brown or chocolate brown, with a smallish tuft four-fifths way out on the third feather. 19–29 mm.

May to August.

Quebec to North Carolina and the Pacific.

4. **P. auriga** Barnes and Lindsey. Dark brownish gray with normal markings (as in *P. edwardsi*). Inner margin of third feather with a triangular tooth, the scales successively shorter outward. Abdomen with oblique pale and dark stripes above and longitudinal ones below. 18 mm.

May to September.

New York to North Carolina. New York: Ithaca.

P. petrodactyla, of the Arctic region, belongs to this group. White, dusted with gray-brown; terminal line gray; fringes white, slightly darker outwardly on hind wing. No triangle of fore wing. Legs gray. Tuft very weak or absent.

III. *Tuft on inner margin distinct, at middle of third feather; palpi and frontal tuft short.* (Platyptilia; Fredericina *Tutt*).

5. **P. tesseradactyla** Linnæus. Ash-gray, dusted with white, and somewhat shaded with brown. A white subterminal line across both feathers, and a faint trace of the dark costal triangle, opposite the bottom of the notch, with a small white bar beyond it; a few spatulate black scales on inner margin. Hind wing darker, with a rather diffuse tuft of black scales. 15 mm. (*Fredericina* Tutt.)

May. Caterpillar boring in stem and flowers of Gnaphalium, hibernating part-grown, and pupating upright in the boring, the pupa normally emerging. Larva

brown, with large white dorsal patches, with primary setæ only; iv and v one tubercle, vi of two setæ.

Northern; south to Pennsylvania and Colorado; also in Europe. New Y Crosby (Yates County), Ithaca, West Danby, Karner.

6. **P. carduidactyla** Riley. Fore wing dark wood-brown or tawny brown irregular antemedial oblique blackish shade; a contrasting chocolate-brown angle over end of cell, touching the costa, at least at its outer end, with a p band beyond it; a more or less distinct, paler, subterminal band across feathers. Fringe of inner margin white, cut with black. Hind wing with a marked triangular black-tipped tuft at middle of third feather, and some scatt scales. 20–27 mm.

May to September. Larvæ several together in a web in heads of thi Light straw yellow; head, cervical shield, thoracic legs, tubercles, and anal p black; eleventh segment with two transverse black marks. Pupa very slig angular.

General.

IV. *Hind wing with a strong tuft about three-fifths way out on t feather, and a very small one at apex; fore wing with a strong tuft bey middle of inner margin. Palpi and frontal tuft short* (Amblyptilia).

7. **P. punctidactyla** Haworth. Fore wing mottled, brownish black and cre white, with a blackish triangle and band before the subterminal line. 16–18 (*cosmodactyla* Hübner, *monticola* Grinnell).

Larva green, with green prothorax; secondary hair fine, not clubbed, do primaries single-haired, subventrals with two hairs; on flowers and young s of Stachys, columbine, geranium, and other herbs.

Northern Illinois and west; doubtful eastward. Europe.

8. **P. acanthodactyla** Hübner. Similar to *P. punctidactyla*, less mottled, strongly shaded with wood-brown and gray.

Larva with several-haired warts, the longer hairs swollen just before t tips, and with fine, somewhat clubbed, secondary hair; tubercles iv and v uni On mints, Ononis, Pelargonium, Euphrasia, and others.

Europe; California. All eastern records are doubtful. New York: Otto West Farms (doubtful).

V. *Third feather of hind wing relatively short, with a very large tuft beyond the middle. Front only a little rough-scaled, without any conical t* (Eucnæmidophorus *Wallengren*).

9. **P. rhododactyla** Fabricius. Bright ochre yellow; fore wing with an obli white streak reaching inner margin at one-third, a patch in the cell beyond middle, and a postmedial line, touching the base of the notch; with a little d brown before it. Hind wing gray-brown. 20 mm.

June. Larva a leaf roller on rose; with fine clubbed secondary hair; primar distinct, but somewhat associated with secondaries to form rudimentary war iv and v united.

St. Louis, Missouri; probably introduced from Europe.

2. *OXYPTILUS* Zeller

(*Pterophorus* Latreille, not Hübner; Geoffroy, in part)

Similar to Platyptilia; no distinct frontal tuft; palpi slender, second segme with a slight apical tuft, third pointed. Fore wing with first feather in species simply lanceolate, with the hind angle only indicated by a black t

in the fringe; second feather strongly falcate. One radial sometimes lost; R_2 stalked; M_3 stalked with Cu_1. Hind wing with a heavy black tuft in the dorsal fringe on the apical fourth of the third feather, and in our species with a heavy tuft opposite it in the costal fringe of the feather. (Larva, fig. 407.)

Key to the species

1. Ground ochre yellow.....1. *periscelidactylus.*
2. Second segment of palpus not tufted.
2. Second segment of palpus tufted at apex below.....3. *delawaricus.*
1. Ground dark brown.....2. *tenuidactylus.*

1. **O. periscelidactylus** Fitch. Tawny or ochre yellow, including the head and thorax. Palpi orange and white; antennæ white above, barred with brown. Fore wing with postmedial line white, crossing the two feathers well beyond their separation, and continued as a fine and broken line around the base of the notch from one feather to the other. Subterminal line white, practically crossing the first feather, but not reaching the inner margin of the second. Hind wing with first two feathers chocolate brown, third nearly white, with a blackish apex. 18 mm.

Rather common from the end of May to July. Caterpillar with tufted hair and fine clubbed secondary hair; webbing together the growing tips of grape, but injurious only in localities where it occurs exceptionally early, as otherwise it only damages the shoots which are soon to be pruned away. Pupa suspended in the web.

Generally distributed. New York: Vicinity of Buffalo, Union Village, Batavia, Ithaca, Schenectady, Albany, Menands, Poughkeepsie, New Windsor, Scarsdale.

2. **O. tenuidactylus** Fitch. Antennæ black and white. Dark brown with some coppery tint, and often more or less tawny, or heavily mixed with black; postmedial and subterminal lines as in *O. periscelidactylus*. Apical fringe sometimes pale yellow (*delawaricus* of collections). Hind wing blackish, the third feather with some white near the middle; under side of first feather with fine postmedial and subterminal lines. Hind tibiæ with spurs at middle; hind tarsi lightly barred with black, except at base. Abdomen brown, third segment with diverging white stripes, fourth all brown, fifth mostly white above; below, with fourth segment mostly white, and much white on the other segments. 12 mm.

May; July and August. Caterpillar on blackberry.

Generally distributed and common. New York: Keene Valley, Geneva, Wells, vicinity of Buffalo, Rock City (Cattaraugus County), Ithaca, Schenectady, Albany, Poughkeepsie.

In **O. cygnus** Barnes and Lindsey, from Iowa, each segment of the abdomen is marked with white, above, the fourth as heavily as the others.

O. raptor Meyrick, from Colorado and Hessville, Indiana, differs from *tenuidactylus* in the upper spurs of the hind tibiæ being well beyond the middle. Abdomen with some white scales on hind margins of segments only. June to September.

3. **O. delawaricus** Zeller. Ochre yellow, like *O. periscelidactylus*. Second feather of fore wing less markedly falcate, and markings less clean-cut. Tuft on second feather of hind wing weaker. 13–20 mm. (*bernardinus* Grinnell, and *raptor* Meyrick, in part).

June and early July; apparently rare.

Quebec to New Jersey; west to the Pacific.

3. *TRICHOPTILUS* Walsingham

(*Buckleria* Tutt)

No frontal tuft; palpus with second segment tufted; fore wing more deeply cleft, full two-fifths the length of the wing; both feathers linear, much narrower than their own fringes, and without dorsal angles. Hind wing with feathers linear, the third with a strong tuft two-thirds way out.

1. **T. lobidactylus** Fitch. Fore wing with basal half mixed clay-color, blackis and white, shading into solid blackish on outer half. Each feather with tv white bars; fringe blackish, white toward apex of costa, and with some whi scales in dorsal fringe. Hind wing dark. 15–20 mm.

June. Larva on Solidago; green with ochreous head and some black point with subdorsal chitinous plates bearing setæ i and ii, which are single and clubbe arising from a large brown chitinous plate; iv and v united; a few pale secondari partly associated with the primaries. Pupa truncate, with four short anteri horns, and subdorsal ridges reaching to fourth segment of abdomen, bearing set i and ii; green, marked with pink. The species is somewhat variable locally.

Massachusetts to Florida. New York: Ilion, Ithaca, New York City.

4. *STENOPTILIA* Hübner

Similar to Pterophorus in appearance, or with the lobes distinctly and ver obliquely truncate. Front with a tuft of scales, normally covering a strong horn cone, ocelli present, palpi long and porrect in our species. Tibiæ smooth. Fo wings cleft a third way to base (fig. 403). Venation practically complete.

A cosmopolitan and very primitive genus, running into the lower forms c Platyptilia, and leading to the Pterophorini. Larva (of *pterodactyla*) with den secondary hair on the cervical shield, unlike the preceding group; with warts an secondary hair on body, the latter clubbed. Two distinct subprimaries behind tl spiracles. The larvæ are borers in the fall, and external feeders in the spring They hibernate part-grown.

1. **S. pterodactyla** Linnæus. Body ashy; legs yellowish; tips of palpi white fore wings and thorax reddish brown; costa and apices of lobes heavily scale with dark brown; a reniform dark fissural spot; fringe and hind wing darke fuscous; terminal line paler. Nearly 25 mm.

Caterpillar green; on Veronica.

Europe. Reported from West Farms, New York.

2. **S. exclamationis** Walsingham. Lobes of fore wing distinctly obliquely trun cate. Gray-brown; a distinct subterminal blackish shade on first feather, and white subterminal line, besides the usual dark antemedial dot in cell and disca bar. 18–24 mm.

This species is obviously a transitional form to Platyptilia; it flies in July and August.

Ottawa, Ontario, and west.

S. mengeli Fernald, an ash-gray species without the heavy costal shade or dash is known from Greenland and British Columbia.

5. *MARASMARCHA* Meyrick

Similar to Stenoptilia, R_2 stalked, R_3 lost. Our species (at least) with well marked scale tufts in inner fringe of fore wing, but none on hind wing.

1. **M. pumilio** Zeller. Light brown, dusted with white, especially toward the dorsal margin; posterior half of thorax, with tips of tegulæ, abdomen, and base of inner margin of fore wing, pale yellow. Fore wing with a blackish antemedial spot in the fold, and one in the cell; a spot at end of cell. Fringes and hind wing grayer. 15 mm. (*ambrosiæ* Murtfeldt, in part; *liophanes* Meyrick.)

Larva possibly on Ambrosia or some Papilionaceous plant; moth flying northward in August and September.

New Jersey to Missouri and south; Old World tropics.

6. *OIDÆMATOPHORUS* Wallengren

terophorus Geoffroy, in part, not Hübner; *Leioptilus* Wallengren, in part; *Alucita* of Meyrick; Linnæus, in part, etc.)

No ocelli. Front without definite tuft, or more or less loosely conically tufted; pi moderate, sometimes rough-scaled or tufted at apex; hind tibiæ and tarsi st often smooth-scaled. Fore wing (fig. 400) normally cleft a third way to base, rather more; with two lanceolate lobes. Hind wing with the first feather lanceate, the third linear, without any black scales in fringes. Fore wing with R_3 lost, other veins free; M_2 running to the lobe, well above the notch; hind wing with Cu lost, first feather without dorsal angle, R running almost to its apex; second ther also lanceolate.

A large and moderately varied genus, dominant in North America; absent from stralia.

Caterpillar (fig. 406) normally with distinct warts, and living more or less osed A few species are said to be borers, with simple hair only (*Adaina* ?). ere may be a few subprimaries, but never secondary hair. Pupa suspended.

Key to the species

1. Fore wing lemon yellow, contrasting with the chocolate-brown hind wing. 15. *sulphureodactylus.*
1. Fore wing not yellow, or hind wing hardly darker.
2. Fore wing with a dark postmedial costal dot or patch opposite the base of the cleft, sometimes connected with a spot before the base of the cleft.
3. Posterior edges of abdominal segments with paired black dots; ground gray ..... 6. *inquinatus.*
3. Abdomen otherwise marked, often with unpaired dots.
4. Ground white; middle tibiæ with a well-marked median tuft.. 9. *elliottii.*
4. Ground not white, or tuft on mid-tibiæ slight or absent.
5. Smallish (22 mm.); white, coarsely irrorate with gray; tuft on middle tibiæ slight or absent..... 7. *linus.*
5. Larger, or middle tibiæ tufted, or more fully marked.
6. Fore wing white with clouded markings, and a distinct oblique shade; tuft weak..... 5. *brucei.*
6. Fore wing not white, or tuft on mid-tibiæ strong.
7. Fringe on inner margin of fore wing white or with white tufts; hind legs annulate; mid-tibia with strong tuft.... 3. *eupatorii.*[39]
7. Fringe with traces of white, or none, on inner margin.
8. Clay-color, lightly powdered, with a contrasting brown triangle on cleft..... 1. *cretidactylus.*
8. With more abundant dark dusting, leaving the veins often pale; wings narrower; less mottled..... 4. *cineraceus.*
2. No dark mark opposite base of notch, on costa, but sometimes one halfway between this point and apex.
3. Fore wings narrow (1/6 as wide as long); fringe of second lobe wider than its lobe; middle tibia with two distinct tufts; hind tarsus with a more or less distinct dorsal crest..... 16. *monodactylus.*
3. Fore wing broader with narrower fringe; no crest on hind tarsus.
4. Snow white, with no tuft on mid-tibia; fore wing with at most a slight dark dot at notch..... 8. *homodactylus.*

[39] *O. mathewianus* is always paler, with white hind legs and weaker tufts.

4. Cream-white or darker.
5. Spot at cleft an oblique shade, extending toward costa; fringe gray and white.....2. *mathewian*
5. Spot at cleft round, or perpendicular to costa, or continued as a sh into upper lobe, or double.
6. Brownish, often with a double discal dot at lower angle of cell; blackish shade in fold to middle of wing; expanse 30 mm. 14. *balano*
6. Not brownish, or small; often with dark points at ends of veins.
7. With a dark dot near base of cleft.
8. Dot lying before base of cleft, terminal dots on second l lacking or faint. Hind wings grayish.....11. *paleace*
8. Dot lying at base of cleft.
9. Fore wings more or less tinged with clear yellow; at m with one terminal dot at apex of second lobe. 10. *stramine*
9. No trace of clear yellow. Terminal spots evident, so times conspicuous.....13. *kellicot*
7. No dot at base of cleft, or faint traces; outer margin w more or less distinct marginal dots or bars...12. *lacteodactyl*

I. *First two feathers of hind wing lanceolate, third with relatively narrow fring hind tibiæ with upper spurs subequal, typically without a small tuft of h scales on dorsal side a little above the spurs; hind tarsi without crest* (Oid matophorus, Leioptilus).

1. **O. cretidactylus** Fitch. Brownish or creamy white; head, except betwe antennæ, and sides of abdomen, brown; legs white with some light brown; n annulate. Fore wing shaded with brown on apex and dorsal margin, a dark fa fissural spot, sharply defined on the outer side, connected by a bar to costa. Hi wing mouse gray; fringe not so dark as in *P. eupatorii*. 25 mm.

Late June and July.

New York and Essex County, New Jersey. New York: Vicinity of Buffalo.

2. **O. mathewianus** Zeller. White, more or less shaded with tawny brown a dark brown scales; sometimes forming spots on the costa and an oblique sha at the end of the cell, followed by a white line. Fringe on inner margin of fi feather with a brown patch, followed by a white bar. 21–27 mm.

Western States. A very pale specimen apparently of this species has been tak by McDunnough at Sebec Lake, Maine.

3. **O. eupatorii** Fernald. Legs brown; hind tarsi mostly white, but annula with brown, fore and middle tarsi white. Fore wing pale gray-brown, dust with dark brown or yellowish white. Fissural spot diffuse, oblique, tending form an oblique streak by joining with the spot on costa of first feather; a pa streak from base below costa almost to apex, not contrasting in very pale spe mens. Costal edge marked with a heavy black bar opposite the fissural strea and two smaller bars beyond. Second feather also sometimes streaked. Fring blackish, the dorsal very heavy and contrasting, with black dots at base, c with white, Hind wing dark gray. 22 mm.

Caterpillar social, on *Eupatorium purpurascens*. Pale green; when nearl mature, shaded with reddish, with an orange-ochre head, a yellow dorsal, a fai and broken subdorsal, passing over tubercles i and ii, a narrow lateral, above ii and a broken stigmatal line. Principal dorsal setæ long, *black*, rough, wart i with two long setæ; iv+v with five longer white hairs, vi similar, a small su primary behind the spiracle. Cervical shield with a fringe of white hairs ove hanging the head, in front, and scattered black hairs behind. Pupa normal, gree with subdorsal reddish shades. Moth in July.

Montreal to Pennsylvania, Illinois, Vancouver, Idaho, and California. New York: Ithaca, Van Cortlandt Park, New York City.

4. **O. cineraceus** Fish. Grayish to brownish white. Thorax often with the tips of the tegulæ darker; abdomen darker with a pale dorsal band containing dark dots; tibiæ tufted; tarsi usually annulate. Wings narrow. Fore wing, in dark specimens, with pale veins; dusted with black scales, sometimes very sparsely; base of cleft white, preceded by the usual black dash; with a spot opposite it and dark subterminal dots on the costa. 28 mm.

O. cineraceus differs from *O. cretidactylus*, and from *Adaina ambrosiæ*, which may run to it in the key, by the narrower wings not mottled on the basal half.

Pennsylvania; western States.

5. **O. brucei** Fernald. Pure white. Scale tufts on fore and middle tibiæ nearly obsolete. Fore wing with more or less gray-brown scaling, becoming a strong gray mottling in dark specimens, with the usual dark spots on cell and costa. Subterminal costal spot confined to membrane. 22–27 mm. (*chionastes* Meyrick.)

June to August.

Pennsylvania, western States. Massachusetts (?; my specimen is not at hand and may belong to another of the light gray species of this genus).

6. **O. inquinatus** Zeller. Similar to *Adaina ambrosiæ*, normally larger, without any brownish tint; costal markings similar, but practically confined to the fringe; the dorsal fringe with clear white bars, two of those in the dorsal fringe of the second feather conspicuous. Abdomen with paired black dorsal dots, mottled with white. 20 mm.

June to September. Caterpillar apparently undescribed, on Ambrosia. Of the species confused with this by Miss Murtfeldt, and apparently bred by her from the same food plant, *Adaina ambrosiæ* is distinguished by the clay color or light wood-brown shading in the axis of the first feather of the fore wing, and by the unpaired black dorsal dots on the abdomen; and *Marasmarcha pumilio* by the black tufts on the inner margin, as well as by the structural characters.

New York to Illinois, Iowa, California, and south. New York: Ithaca.

7. **O. linus** Barnes and Lindsey. White. Fore and middle tibiæ with longitudinal gray stripes, not tufted; hind tibiæ with gray on spurs, and sometimes at tarsal joints; abdomen with a series of mid-dorsal dots, sometimes connected. Fore wing narrow, more or less dusted with black, especially at the apices of the feathers and on the inner margin; usual postmedial markings present; a few blackish dots at tips of veins, sometimes lost in the black dusting; fringe gray, cut with white at the veins. Hind wing brownish gray. 22 mm. (*brucei* in part ?; *lienigianus* Zeller ?.)

The coarse black dusting is characteristic.

June and July.

Hampton, New Hampshire, to Pennsylvania and Ohio.

8. **O. homodactylus** Walker. Pure white. Fore wing with a little gray shading on under side, and with traces toward costa above. Sometimes with a faint darker dot at base of cleft, and dots at tips of veins. Middle tibiæ with a fringe of scales, but no tufts. 25 mm. (*elliottii*, in part).

This species is usually confused with *O. elliottii*, from light specimens of which it is sometimes only distinguishable by the different tufting of the mid-tibia. The single New York record below is based on specimens determined by Barnes and Lindsey; it is probably not rare, but confused with *elliottii*.

Larva on Solidago. Green with yellowish head and a broken irregular yellow dorsal line; a yellow lateral line, above iii, and traces of a stigmatal on the thorax. Hair whitish, slightly barbed; tubercles i and ii contiguous, i with 4 setæ and ii with 2 long and 2 shorter ones, ii with two short and a long; iv+v and vi each with about 12 hairs; posterior part of segment with a single hair behind iii and a small wart with 4 hairs behind iv+v. Prothorax with two patches of hair point-

ing forward, and some posterior hairs, mostly on three warts. Pupa green wit white hair, the wing cases smooth, with one row of short hairs; with cream dorsa subdorsal, and subventral stripes, and a broken lateral, the subventral on the ridg

Quebec to New Jersey, British Columbia, and California. New York: Ithaca.

9. **O. elliottii** Fernald. White; head brownish. Fore wing normally with trace of the usual spots and oblique bar at the base of the notch; sometimes practicall immaculate. Fringe brownish except in the cleft. Middle tibia with a strong tuf 22–25 mm.

June and July. Larva on Eupatorium; light green, with smooth shining whit hairs; head pale ochreous. A broken, yellow dorsal line, lateral, stigmatal, an traces of a subdorsal; tubercles i, ii, and iii with one strong hair each, iv+v wit four long hairs, the wart behind it with a couple of short ones; only vi with twelv hairs. Pupa similar to that of *homodactylus*, with several rows of hairs on th wings, shorter hair generally, and with a mid-dorsal hair on several segments.

Quebec to New Jersey; west to Illinois and Manitoba. New York: Ithac Nassau (?).

10. **O. stramineus** Walsingham. More or less ochreous yellow; head brown i front and above; abdomen with brown dorsal and ventral lines. Fore wing usuall with a distinct brown spot at the cleft; tips of veins sometimes brown; frequentl with a brown shade from the base near the inner margin to the apex of the firs feather, the apical part of the shade most persistent. Fringe and hind win grayer. 15–21 mm.

July to September. A larva, possibly of this species, occurs on Anaphalis i Colorado. It is white, heavily granulose with black, and with a brownish blac head.

Eastern Canada to New Jersey, and west to the Pacific. The specimens recorde below as of *sulphureodactylus* may belong here, as they are small, but all thre have lost their abdomens.

11 **O. paleaceus** Zeller. Very pale brownish gray; head brown, pale betwee antennæ. Fore wing shaded with pale fuscous on costa outwardly, and tendin to show a pale longitudinal streak below the costa, rarely suffused with brown a darker spot at base of fissure. Legs yellowish white, shaded with fuscous below (The ground is usually the light buff of Ridgway's *Nomenclature of Colors fo Naturalists*,— 17′f or 17″f.) 19–26 mm. (*sericidactylus* Murtfeldt.)

Two broods. Caterpillar on Vernonia, varying from greenish white to dul salmon, the shorter hairs sticky. Pupa varying in color.

General south of Canada.

12. **O. lacteodactylus** Chambers. Cream white, with more or less distinct dar dots at tips of veins, but at most a faint dot at the cleft. 25–28 mm. (*kellicotti* of collections, in part.)

May to July.

Nova Scotia to North Carolina and California. New York: Portage, Potte Swamp (Yates County), Ithaca; Lynbrook, Long Island.

13. **O. kellicottii** Fish. Cream color, slightly streaked with brown, and some times with some scattered black scales; dark brown fissural dot; brown termina dashes, usually one above the apex and two below on the first feather, and four on the second. Wing slightly translucent between the veins. Hind wing silky brown gray; legs whitish. 30 mm. (*chlorias* Meyrick.)

June. Larva unknown. The larva described as of this species is obviously a Platyptilia.

Laurentians, Quebec to Pennsylvania. New York: Ithaca.

14. **O. balanotes** Meyrick. Brownish white, suffused more or less with brown; abdomen striped. Palpi exceptionally long, long enough to reach base of antennæ if turned up. Fore wing, when fully marked, with dark brown spots at tips of veins, a double spot at lower angle of cell, and a powdery streak from base of

fold to below end of cell, offset upward at half its length; these markings all variable. (25) 30–41 mm.

Larva in stem of Myrica.

New Jersey; southern United States.

15. **O. sulphureodactylus** Packard. Bright sulphur yellow, slightly tinged with brown; with more or less distinct traces of the usual markings. Hind wing chocolate brown, contrasting. 25 mm. (*sulphureus* Walsingham.)

September.

Western States. Woods Hole, Massachusetts, and Hemlock Lake, New York (?). The eastern specimens are undersized, and their determination not certain.

O. inconditus Walsingham has been reported from the District of Columbia, presumably in error for one of the species just described. It is somewhat similar to *lacteodactylus*, but without the dark points at the ends of the veins, and is typically grayer.

II. *All three feathers of hind wing linear, the third with a very broad fringe; hind tibiæ with upper outer spur only three-fifths as long as inner; with a small tuft of hair scales a short way above them.* (Pterophorus; Emmelina *Tutt*).

16. **O. monodactylus** Linnæus. Pale grayish or pinkish brown (in the typical form from Europe with a decided yellow tint). Fore wing sometimes with a little black and white dusting; with a dark fissural spot or wedge; a dark subterminal bar on the costa, and two smaller spots beyond it; and dark spots on both feathers; all relatively slight. Hind wing and fringes normally chocolate brown. 28 mm. (*pterodactyla* Hübner not Linnæus, *cinereidactylus* Fitch, *pergracilidactylus* Packard, etc.).

Caterpillar on Convolvulus and several other herbs. Bright yellowish green; head pale yellow. A narrow dorsal and broader stigmatal yellowish white stripe. Hairs grayish, in tufts from tubercles. Under side paler. Pupa green with blackish brown dorsal and lateral lines, and streaks on wing-cases; head flattened, hairy, marked with brown; part of dorsal hairs blackish.

Nearly world-wide, but running to well marked local forms. New York: Wilmington, vicinity of Buffalo, Ithaca, Schenectady, Albany.

7. *ADAINA* Tutt

(*Pterophorus, Alucita, Œdematophorus,* in part)

Similar to Oidæmatophorus, but with R_2 and R_4 stalked. Tibiæ not tufted, wings, on the average, narrower.

Neither of our species is typical of the genus, and they should perhaps be restored to Oidæmatophorus. In the typical species the larva is a borer, with simple hair, except for a couple of extra hairs associated with seta vi; our species agree with those of Oidæmatophorus.

1. **A. montana** Walsingham. White, lightly dusted with brown, the dusting gathering into a bar at end of cell, and a subterminal shade on costa. Fringe white, cut with brown below apex of first feather, and above apex of second. Hind wing browner. 16 mm.

July. Caterpillar on leaves of Solidago, full-grown in June. Pale green with a triple fine white dorsal stripe, and "seventh to ninth rings" yellow. Tubercle i with one hair, ii with two, iv and v as warts. Pupa green, sometimes with a red dorsal stripe; suspended. The egg hibernates.

California. New York: Buffalo.

A. declivis Meyrick is considered by Barnes and Lindsey to be a variety of *montana*. Moth somewhat darker, shaded with brown dusting, and with more fully developed brown markings.

June and July. Larva in heads of Helianthus in late May. Warts **i** and **ii** approximate with one long and several short hairs, **iii** simple, **iv+v** a regular wart, the wart behind it with several hairs. Warts black; two black lines on dorsum of prothorax. Hairs white, spinulose. (This description is probably more accurate than the one above.)

Ontario; Manitoba; Colorado.

2. **A. ambrosiæ** Murtfeldt. White, more or less irregularly dusted with black, with a more or less distinct luteous to brown streak through the middle of the first feather, the feather above it and costal fringe white, with a heavy black patch near base of first feather and a narrow one near tip; the brown streak defined below with some black scales. Dorsal fringe of first feather dark gray, cut with two or three paler bars. Notch edged with white, preceded by a strong blackish shade, which is extended toward the inner margin by dark suffusion. Hind wing gray, base of fringe somewhat yellower. 15 mm. (*inquinatus*, in part.)

Late June: late August and September. Larva on Ambrosia, with barbed setæ, those of warts i and ii short and recurved; subprimaries near **i** and **ii**; warts **i** and **ii** conical, brown, **i** with a tuft of long hair, with a black lenticle above it; dorsal line yellow, faint, sides with **V**-shaped oblique stripes, pointing forward. Pupa green with a brown dorsal stripe.

Illinois; Missouri; Florida.

Family 35. **ORNEODIDÆ**

(Alucitidæ)

Moderately slender moths, with the wings each divided into six feathers; in our species, nearly to the base. Head prominent, scaled, with ocelli and tongue; palpi long and rough-scaled; maxillary palpi rudimentary. Each wing broad as a whole, but each feather linear, much narrower than its fringes, and each with a single strong vein, (these being: **R**, $\mathbf{M}_1$, $\mathbf{M}_2$, $\mathbf{M}_3$, $\mathbf{Cu}_1$, $\mathbf{Cu}_2$ or **A**). Female frenulum of two bristles; male with a scent-pocket in last feather.

Egg rough, of flat type; larva rough and granulose (fig. 408), with small head, held nearly horizontal; primary setæ only; prespiracular wart and subventral of prothorax each with two setæ; subventral of meso- and metathorax with one seta; prolegs with a complete circle of uniordinal hooks. Spiracles circular. Pupa obtect, with Adelid type of prothorax; maxillary palpi concealed; dorsal head-piece enormous; seventh segment of abdomen immovable in both sexes. Dehiscence of macro type: with the antennæ attached to the legs; but the dorsal head-piece coming away separately; appendages nearly reaching tips of wings, second leg touching head, tips of third legs exposed; cremaster with 10 or 12 recurved spines. Setæ **iii** and **iv** distinct.

1. *ORNEODES* Latreille

(*Alucita* Curtis, and others[40])

Characters of the family. Wings cleft nearly to the base.

1. **O. montana** Cockerell. Dull light gray, each feather barred with blackish; with narrow white bands before and beyond each bar. 14 mm. (*hexadactyla* of authors, not Linnæus; *huebneri* Wallengren?)

[40] By the type-fixation rule, *hexadactyla* would become the type of Alucita as fixed by Curtis.

April. (In Europe *O. hexadactyla* is reported as emerging in July and overwintering). The caterpillar of the European *O. huebneri* is translucent red, with darker shining head and cervical shield; reported from flowers of Centaurea and Knautia; also, perhaps in error, from honeysuckle and scabious. Pupa in a cocoon.

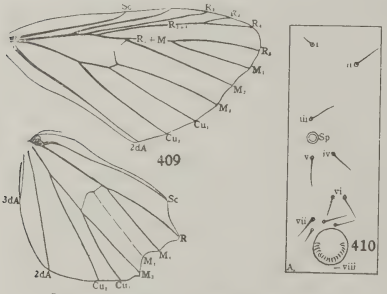
New York to Western States. New York: Ithaca. (Possibly introduced).

SUPERFAMILY **URANIOIDEA**

This superfamily is, in the main, made up of rather slender moths, with vestiture mostly of scales, and thin ample wings; the North American species closely resembling the geometers. Antennæ normally simple, prismatic, pectinate in a few exotic forms; palpi slender and upcurved; maxillary palpi minute, of porrect type, apparently absent in the northeastern species; tongue coiled, somewhat weakened. No ocelli. Fore wing with $\mathbf{R}_3$ and $\mathbf{R}_4$ stalked (fig. 409), widely separated from $\mathbf{R}_5$ which is approximate or stalked with $\mathbf{M}_1$; **3d A** running into **2d A** near base, or obsolete; **1st A** lost. Hind wing with enlarged humeral angle, supported by a more or less distinct humeral vein; its outline usually irregular, angled or tailed; **1st A** lost, **3d A** normal. Other characters as given in synopsis. The superfamily includes the exotic Uraniidæ and Epicopeiidæ, as well as the Epiplemidæ, and is a characteristically tropical group.

Family 36. **EPIPLEMIDÆ**

Frenulum present, fully developed, attached to the tip of the humeral angle; retinaculum of bar type (as in the Arctiidæ). Caterpillar (fig. 410) of our species microlike in appearance; when young, social in a web; later, feeding more exposed; head normal with front extending about halfway to vertex; without tufted or secondary setæ, but with a subprimary seta associated with **vi**; **vii** represented by two setæ on prothorax, one on first segment of abdomen, two on second, and four on the leg-bearing segments; setæ **iv** and **v** on a level, and well below the level of the spiracles; approximate on first three segments of abdomen but on the others widely separated; prolegs normal, with biordinal hooks in a sharply curved band. Pupa in a cocoon, not studied. Our two genera are typical of the family, though unusually small. Some of the exotic forms are striking.



FIGS. 409–410. EPIPLEMIDÆ

409, Venation of *Callizzia amorata;* **410**, *Callizzia amorata*, seta map of middle segment of abdomen (after Fracker)

Key to the genera

Fore wing deeply notched, toothed at middle and anal angle....1. **Calledapteryx.**
Fore wing with even outer margin.....2. **Callizzia.**

1. *CALLEDAPTERYX* Grote

Fore wing with arched costa, sharply curved down at the apex; outer margin toothed below M_3, deeply excavate above, and slightly below the tooth; anal angle broadly toothed, and inner margin sinuate. Hind wing with very strong teeth on **R** and M_3, and lesser ones on the other veins, especially M_1. Fore wing with R_1 and R_2 well separated, arising from cell; R_3 and R_4 long-stalked from well before end of cell; and R_5, M_1, and M_2 from the apex. Body slender, antennæ simple, a little prismatic, palpi small; hind tibiæ swollen in male. The moth rests with the fore wings held somewhat rooflike, covering the hind wings, which are wrapped about the body.

1. **C. dryopterata** Grote. Light brick red to dull brown; ground narrowly blackish along the margin; two roughly parallel dark lines, with a brown shade between them at inner margin; a dark brown line just within the outer margin on upper half of wing. Hind wing similar, the two lines often distinct only at the inner margin. 18 mm. (**H 42**:17.)

May to early June; August. Caterpillar on *Viburnum prunifolium* (but not *dentatum* or *Lentago*). Head light brown, heavily spotted with black; body greenish white, more or less spotted with black, the black tending to form a dorsal line and a subdorsal band, especially toward the rear. Pupa in a slight web at surface of ground.

St. Johns, Quebec, to Alabama; west to Manitoba. New York: West Farms, (Angus); Corona, Long Island.

CALLIZZIA Packard

Head broader than in Calledapteryx; fore wing (fig. 409) with arched costa, outer margin only slightly bent at middle. Inner margin and hind wing not quite so irregular as in Calledapteryx.

This genus is hardly distinct from Epiplema.

1. **C. amorata** Packard. Ash gray, dusted and shaded in two shades; two fine dark brown lines, joining each other above inner margin, or connected by a bar; a dark patch above middle of outer margin, defined by an angulate dark line; hind wing with inner line almost evenly curved, and outer irregular, with a dark gray shade on disc between them. 18–22 mm.

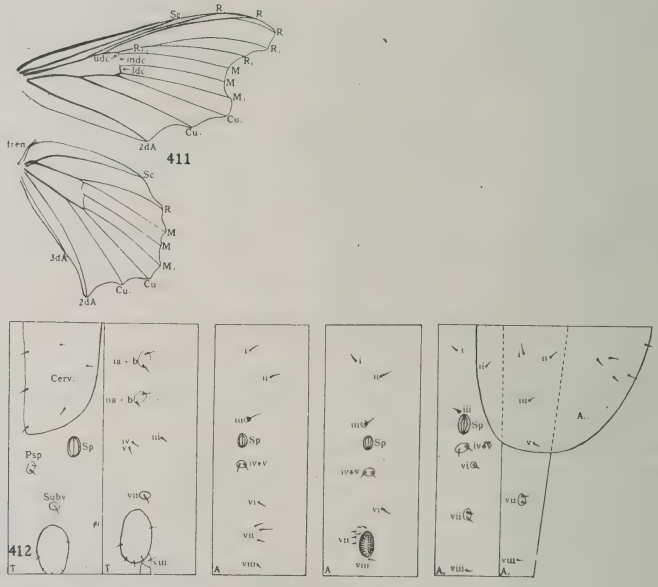
End of June and July Caterpillar apparently concealing itself at the foot of the plant when not feeding; on *Lonicera dioica*. Head whitish with two brown bands, tubercles a little raised; body dull brown with black lateral band, pale subventrally.

Quebec to Virginia, and west to the Pacific. New York: Keene Valley, Mt. Marcy, North Elba, Indian Pass, Newcomb, Ithaca, Big Indian Valley, Albany.

Family 37. **LACOSOMIDÆ**

(Perophoridæ)

Stout, bombyx-like moths, of quite uncertain affinity. Male antennæ broadly pectinate, abruptly narrowing at two-thirds their length. Female narrowly pectinate. Palpi and tongue rudimentary; vestiture deep and mixed. Fore wing falcate, and more or less bent at middle; with thick scaling and heavy veins; $\mathbf{M}_2$ arising from middle of end of cell; $\mathbf{R}_2$ and $\mathbf{R}_3$ long stalked, and close to costal edge, *separated by a wide space from* $\mathbf{R}_4$ *and* $\mathbf{R}_5$ (fig. 411), which are also stalked; $\mathbf{M}_1$ free, connate; $\mathbf{Cu}_2$ arising only halfway out on cell. Hind wing with humeral angle enlarged and strengthened, bearing a minute frenulum or none; **Sc** fused for a short distance at base with **R**, then abruptly



FIGS. 411–412. LACOSOMIDÆ

411, *Lacosoma chiridota*, venation; **412**, *Cicinnus melsheimeri*, seta map of larva

and widely divergent, as in the Epiplemidæ and Saturnioidea; $\mathbf{M}_2$ arising from middle of end of cell. Fore wing with **2d A** only; hind wing with **2d A** and **3d A** normal, and **1st A** more or less distinctly indicated at margin.

The caterpillar (fig. 412), when young, makes a lace-like nest between two leaves; later it forms a portable house of two pieces of leaf, which is lined with heavy silk, very roomy inside, and has a circular opening at each end. When not moving about, it anchors the case with silk, often in a slight nest formed of leaves drawn together, closing one opening of the case with its head, and the other with the circular thickened posterior end of its body. Head rough, more rounded than usual and heavily chitinized, wider than prothorax; body thin-skinned, swollen at middle, and a little flattened; abdomen with seta **i** nearer to middle line than **ii**, even on ninth segment; **iv** and **v** well below level of spiracle and more or less approximate; **vii** composed of 2 or 3 setæ on first, second, seventh, and eighth segments; four (Lacosoma), or seven (Cicinnus) setæ on leg-bearing segments. Prolegs rather short, normal, with a complete circle of biordinal hooks. The full-grown caterpillar hibernates in its case at the surface of the ground, and pupates in the spring, like many micros.

Pupa obtect, of macro type; heavily chitinized, with three movable segments. Head missing in the only specimen before me; tongue rudimentary, as wide as long, with a minute rhomboidal labium between the bases of the maxillæ; fore femur broadly exposed, apparently not quite reaching the eye; fore tibiæ broadly abutting on the eye, middle tibiæ falling far short; the tips of the hind tarsi visible beyond the tips of the middle ones. Antennæ broadly pectinate; no spiracular furrows; abdominal segments 2 to 7, with a double set of alternating teeth near front edge, dorsally, those on segment 7, much the strongest; first segment much reduced. This pupa seems distinctly Saturnioid in character, and agrees with the general impression that this family is related to the ancestral Saturnioidea.

The family is a rather small one, and wholly American.

Key to the genera

Margin of fore wing deeply scalloped (fig. 411) ..... 1. **Lacosoma.**
Margin of fore wing even ..... 2. **Cicinnus.**

1. *LACOSOMA* Grote

1. **L. chiridota** Grote. Deep ochre yellow, red-brown, or dark brown, the male usually darker, with dark brown and white fringe, and more or less distinct postmedial band and discal dots on both wings. 22–30 mm. (**H 41**:21.)

June. Caterpillar in a somewhat clumsy and nearly circular case, on oak, in the late fall. Without clubbed setæ on head.

Massachusetts to Pennsylvania, Iowa, and south. New York: Binghamton, Poughkeepsie, Staten Island, Yaphank.

2. *CICINNUS* Blanchard

(*Perophora;* in part)

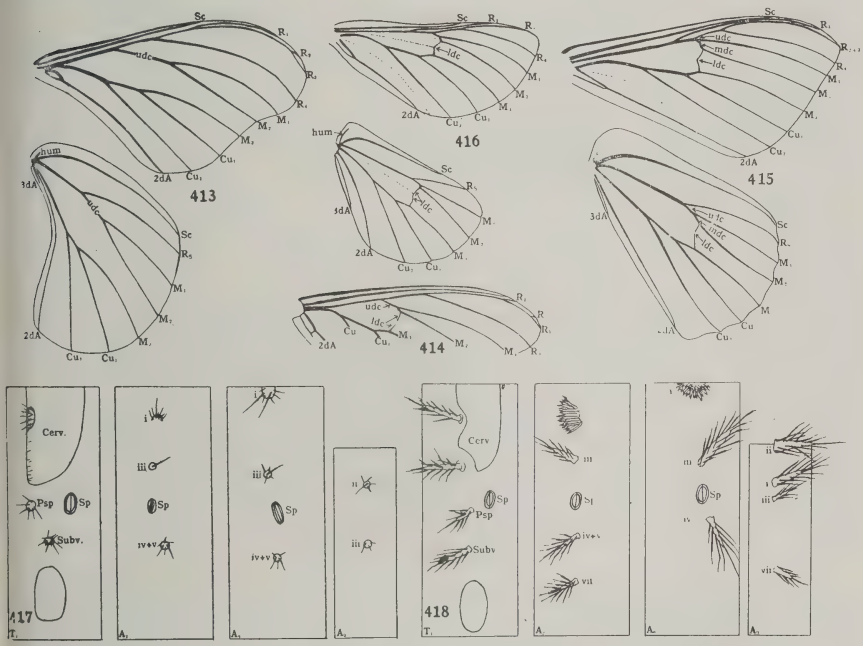
1. **C. melsheimeri** Harris. Wings light gray, shaded with rose, especially toward margin and on under side of fore wing, and dotted with black. A blackish postmedial line, bent sharply at R_5, and more or less traces of an antemedial line on fore wing, and a straight postmedial line on hind wing. A black discal bar. 35–45 mm. (**H 41**:17.)

June. Commonest on sandy barrens. Caterpillar on oak, usually on scrub oak, in an ellipsoidal and rather neatly made case, covered with two pieces of leaf; caterpillar with two long clubbed setæ on the head.

Massachusetts to Wisconsin and southward. New York: Hempstead Plain, Yaphank, Long Island. Will probably prove widespread in sandy territory.

SUPERFAMILY **SATURNIOIDEA**

Large or very large moths. Body stout, relatively large as a rule, with hairy vestiture; head relatively small, more or less retracted,

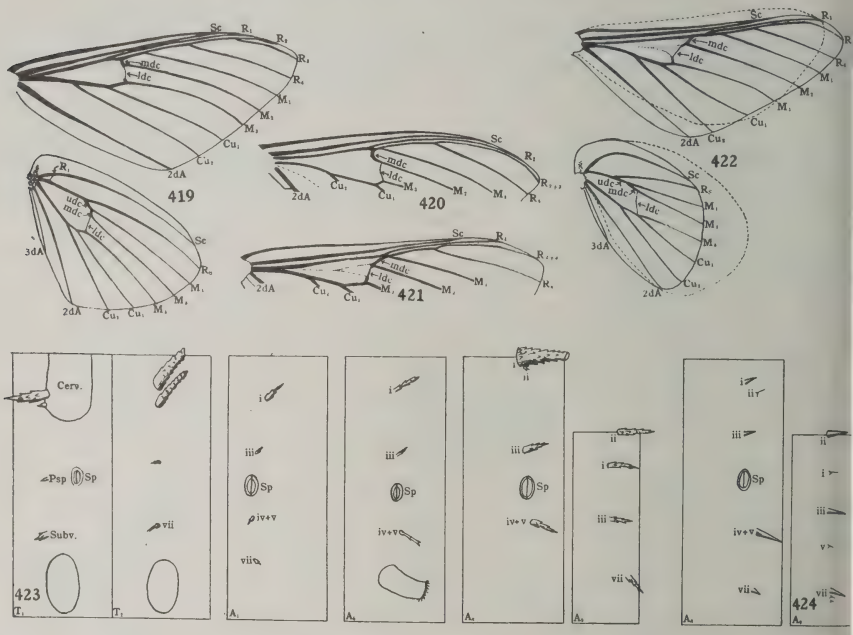


FIGS. 413–418. SATURNIOIDEA

413, *Callosamia promethea*, venation of female; **414**, *Tropaea luna*, venation of costal portion of fore wing; **415**, *Antomeris io*, venation of male; **416**, *Hemileuca lucina*, venation of male; **417**, *Telea polyphemus*, seta map of larva, indicating only the setæ arising from warts, not the secondary setæ; **418**, *Hemileuca maia*, seta map, omitting secondary setæ

often tapering ventrally; ocelli absent, mouth parts reduced, non-functional for feeding, sometimes almost completely absent. Labial palpi small to minute in the North American species. Antennæ bipectinate in the male in all the North American species, and most often in the female also; sometimes extremely broad; normally doubly bipectinate, especially

in the male. Scape densely scaled; but shaft in the North American forms with a few scattered and fugitive scales (Automeris) or none.



FIGS. 419–424. SATURNIOIDEA

419, *Citheronia regalis*, venation; **420**, *Eacles imperialis*, venation of costal part of fore wing; **421**, *Adelocephala bicolor*, venation of costal part of fore wing; **422**, *Anisota virginiensis*, venation (The dotted outline indicates the wing form of *A. rubicunda*, magnified to approximately the same proportions.); **423**, *Citheronia regalis*, seta map, showing spines only, **424**, *Anisota rubicunda*, seta map, showing spines only.

Legs stout, the spurs inconspicuous or absent. Abdomen usually relatively short, but exceeding the hind wings in the more primitive species. Fore wings densely scaled, with heavy veins; one radial at least lost (possibly $\mathbf{R}_5$ if the family is related to the Epiplemidæ); $\mathbf{M}_2$ more or less definitely associated with **R**-stem; the cell weakly closed or open below it. Bases of **R** and **Cu** closely approximate, often for a considerable distance; **1st A** lost, **2d A** normal. Hind wing without any trace of frenulum, with a broadly expanded humeral

angle, supported by a more or less distinct humeral vein; **Sc** and **R** widely divergent almost from base, connected close to base by a rudiment of R_1 in Citheronia; M_1 and M_2 connected with **R**-stem by a full-strength longitudinal vein, the cell weakly closed or open below M_2; **1st A** lost, **2d A** normal; **3d A** very short and rudimentary in the typical Saturniids, which have the inner margin more or less concave toward the body, and not folded.

Egg of flat type, usually thick-shelled, ovoid, without definite sculpture, but often with characteristic markings. Larva in first stage with branching spines bearing several setæ, but with the primary setæ distinct; or, for the major part, with primary setæ only, but with one or more pairs of thoracic spines each bearing two primaries; setæ **ia** and **ib, iia** and **iib** of thorax on single tubercles, **i** and **ii** of abdomen separate, **iv** and **v** of abdomen on a single bifurcated tubercle. Later stages with abundant but usually fine and inconspicuous secondary hair on body, but little or none on head, warts all several-haired, and usually modified into branching spines (fig. 418) or knoblike structures (fig. 417) often with the hairs themselves rudimentary. The spines or knobs often unequal, and some of them often rudimentary. Warts **iii** and **iv+v** usually forming spines; but **i** of the ninth segment of the abdomen single-haired and soon lost in the general mass of secondary hairs. Seta **ii** similarly lost except on the ninth and sometimes eighth segment; **i** of the eighth segment, or **ii** of the ninth, or both, usually (in our species always) fused with their mates on the middorsal line, those of the eighth forming the so-called "caudal horn." The spines of the Hemileucinæ are poisonous (like nettle), and have the setæ modified into conical caps which easily break off, setting free the poison.

Pupæ moderately to heavily chitinized, always obtect, but capable of considerable progression in the Citheroniidæ. Head without transverse sutures; mouth on ventral surface of body; tongue never reaching tip of wings, and normally only about a fifth as long as wings; labial palpi wholly concealed; no maxillary palpi; fore femora exposed; fore and middle legs usually meeting on the middle line behind the tongue, and the wings meeting on the middle line behind them; antennæ very broad, usually more than a fifth as broad as long, larger in the male, where they may almost completely cover the other structures. Abdominal segments sometimes spined but never (as in the Lacosomidæ) with an anterior and no posterior row of spines. Pupa clothed with microscopic secondary hair.

I here recognize two families. Besides these there is a third family in South America, characterized by fully scaled antennæ, and appar-

ently transitional to the Uranioidea. Many authors consider the Hemileuca group also a distinct family, some including and some excluding Automeris. It is certaintly transitional between the Citheroniidæ and Saturniidæ.

Key to the genera, imago

1. M_1 of fore wing distinctly stalked with R-stem (figs. 420–422); antennæ pectinate with simple apex, or simple.
  2. Small species, expanse under 75 mm.; middle discocellular short and oblique inward.
    3. Inner margin of fore wing longer than outer margin; two white discal dots, or none; northern species shaded with crimson on the hind wing (fig. 421) ..... C. 3. **Adelocephala.**
    3. Inner margin shorter than outer margin, (fig. 422), except in forms with a single large white discal dot; our species with more red on fore than hind wing, if there is any..... C. 4. **Anisota.**
  2. Large species, expanse over 75 mm.; middle discocellular oblique outward in general direction.
    3. Mid-discocellular much shorter than lower discocellular, and straight (fig. 419), rudiment of stem of M_{1+2} running into M_2; R_2 present; palpi larger ..... C. 1. **Citheronia.**
    3. Middle discocellular long and angled (fig. 420), base of M_{1+2} running to the angle; R_2 lost; palpi smaller..... C. 2. **Eacles.**
1. M_1 free; upper discocellular much shorter than middle discocellular, and nearly transverse (fig. 415)..... S. 2. **Automeris.**
1. M_1 free; upper discocellular nearly longitudinal, and much longer than middle discocellular, which may be obliterated (figs. 413, 414).
  2. **3d A** of hind wing more than half as long as **2d A** (fig. 416). S. 1. **Hemileuca.**
  2. **3d A** of hind wing rudimentary.
    3. Hind wings long-tailed..... S. 3. **Tropæa.**
    3. Hind wings rounded.
      4. Abdomen with small raised tufts of hair..... S. 7. **Philosamia.**
      4. Abdomen with smooth hair.
        5. Cells closed by a fine vein passing through a transparent spot. S. 4. **Telea.**
        5. Cells open.
          6. R_2 preserved; sexes strongly dissimilar (fig. 413)..S. 5. **Callosamia.**
          6. R_2 lost, sexes alike..... S. 6. **Samia.**

Key to genera, larva

1. A single pair of long spines on thorax..... C. 4. **Anisota.**
1. Two pairs on thorax, and caudal horn much longer than the subdorsal ones on remaining segments of abdomen (fig. 423).
  2. Secondary hairs conspicuous..... C. 2. **Eacles.**
  2. Secondary hair microscopic.
    3. Spines strongly flattened and silvery..... C. 3. **Adelocephala.**
    3. Spines cylindrical.
      4. Five principal spines short and blunt, the others rudimentary. S. 5. **Callosamia.**
      4. All spines long and rough or branched..... C. 1. **Citheronia.**
(Also young of **Eacles** and **Adelocephala**).

1. Spines subequal in length, at least several pairs of subdorsal ones.
  2. Spines minute, mere tubercles, surmounted by long setæ (fig. 417).
    3. Secondary hair more conspicuous; no secondaries on labrum; head green, body with transverse white lines.....S. 3. **Tropæa.**
    3. Secondary hair weaker; a couple of secondaries on labrum, head brown; body with oblique stripes on sides.....S. 4. **Telea.**
  2. Spines long, heavily spinulated, the caterpillar as a whole appearing hairy.
    3. Ninth segment of abdomen with a small spine on mid-dorsal line; spines poisonous (fig. 418).
      4. Subdorsal spines of abdomen truncated, and discolorous in last stage; laterals sparsely spinulated.....S. 1. **Hemileuca.**
      4. Subdorsal spines rather longer than laterals; and both densely spinulated .....S. 2. **Automeris.**
    3. Ninth segment without a mid-dorsal spine....young of various **Saturniinæ.**
  2. Spines small, pointed, and strongly flattened.....C. 3. **Adelocephala.**
  2. Spines modified into knobs, with rudimentary conical setæ.
    3. Four knobs on thorax and caudal horn slightly enlarged, discolorous. S. 6. **Samia.**
    3. Knobs all equal, blue.....S. 7. **Philosamia.**

Key to genera, pupa

1. Pupæ with flanges on anterior edges of movable segments; not telescoping when dried; cocoon slight or absent; cremaster present.
  2. Cremaster distinctly bifurcate, though sometimes shorter than wide; metathorax with a pair of prominent dorsal tubercles; pupa in ground. (Citheroniidæ).
    3. Pupa not spinose, cremaster broader than long, not over 2 mm. long. C. 1. **Citheronia.**
    3. Pupa more or less spinose; cremaster at least twice as long as broad.
      4. Pupa sparsely spinose; posterior row of spines on segments 5, 6, and 7 of abdomen longer than anterior.....C. 2. **Eacles.**
      4. Pupa densely spinose, anterior row of spines on segments 5 to 7 usually longer than posterior.
        5. Pupa with a raised transverse ridge at middle of eighth segment of abdomen, dorsally.....C. 4. **Anisota.**
        5. No such ridge.....C. 3. **Adelocephala.**
  2. Cremaster short, more or less rudimentary, not bifurcate....(Hemileucinæ).
    3. Front edge of segments, above flange-plates, with sharp transverse ridges; pupa in light cocoon.....S. 2. **Automeris.**
    3. Front edge of segments above flange-plates smooth, or with fine longitudinal striation; pupa uncovered.....S. 1. **Hemileuca.**
1. No flanges at anterior edges of abdominal segments, the segments telescoping within each other in a dried specimen; pupa always in a cocoon. (**Saturniidæ**).
  2. Movable part of abdomen (segments 5 to 7) strongly tapering toward rear; pupa strongly humped; cocoon in our species without trapdoor.
    3. Anterior slopes of movable segments of abdomen with three transverse ridges on sides, cremastral hooks in a circular group....S. 3. **Tropæa.**
    3. Anterior slopes of movable segments merely granulose on sides; cremastral hooks in two circular groups.....S. 4. **Telea.**
  2. Movable part of abdomen nearly cylindrical, the pupa less humped; cocoon with a trapdoor.

3. Maxillæ more than one-fourth of the length of the wings, strongly concave on outer edges toward base; anal angles of fore wings opposite spiracles of segment 3 of abdomen.....S. 7. **Philosamia**.
3. Maxillæ a fourth the length of wing or less, not strongly concave on outer side; anal angle of fore wings opposite incisure between third and fourth segments, or further back.
4. Maxillæ less than one-fifth length of wings; antennæ of males with sides tapering gradually to a pointed tip; glazed eye invisible (smaller species).....S. 5. **Callosamia**.
4. Maxillæ about one-fourth length of wings; male antennæ even in width most of their length, abruptly narrowing to the blunt apex; female with part of glazed eye exposed; very large species S. 6. **Samia**.

Family 38. **CITHERONIIDÆ**

(Ceratocampidæ)

Male antennæ doubly bipectinate about halfway to apex, with simple laminate apical fourth or more. Fore wing with $\mathbf{M}_1$ more or less stalked with $\mathbf{R}_{2-4}$, parallel to $\mathbf{M}_2$, middle discocellular vein well developed, cell closed in both wings. Hind wing with **2d A** preserved. Abdomen more or less conical, extending beyond hind wings, sometimes far beyond. Female with antennæ simple; rarely singly bipectinate, with simple apex (*Adelocephala bicolor*); abdomen stouter than in male, and wings often more rounded.

The moth rests with wings folded in a triangle, somewhat rooflike. Egg with rather thin translucent shell, with faint, fine hexagonal sculpture, most distinct in Citheronia. Larva in first stage with primary hair, except in Citheronia; ninth segment of abdomen with a middorsal spine (often rudimentary), anal plate tuberculate or spined; spines more or less horn-like, never with long spinules, and always strongly unequal. Pupa active, formed in the ground, with bifurcate cremaster without hooks, and flanged segments. The pupa hibernates.

A wholly American family, as defined here. Some authors would add to it various genera (mostly exotic) associated with Automeris and Hemileuca, and use the lack of a cocoon as the primary family character.

1. *CITHERONIA* Hübner

(*Ceratocampa* Harris)

Palpi projecting slightly beyond front; tongue rudimentary but coiled. Fore wing with middle discocellular very short, straight and oblique outward; hind wing with a weak rudiment of $\mathbf{R}_1$, running from **R** to **Sc** (fig. 419). Larva (fig. 423) with numerous strong recurved branching spines, the subdorsal ones on meso- and metathorax and caudal horn, very large; the subdorsals on prothorax and laterals of meso- and metathorax also large, and all well developed. Spines in younger stages relatively longer, with fewer spinules.

1. **C. regalis** Fabricius. Fore wing grayish olive, more rarely purple, with orange-red veins and pale yellow spots; a yellow spot at base, one near end of cell, and a broken postmedial series; hind wing mostly orange, somewhat redder on the veins, with a large yellow area toward costa and a smaller one toward inner margin, neither reaching outer margin; rarely, with some olive-gray shades between veins. Body orange-red, striped with yellow. In variety **infernalis** Strecker, the yellow on the wings and body is replaced with orange-red; in variety **sængeri** Neumœgen, the body and markings of the fore wings are wholly yellow. 110–160 mm. (**H 10**:3. **H 1**:4, larva).

Caterpillar blue or green; more rarely, brown or pinkish, with oblique dark and light lateral shades, which are often more or less orange, and black horns, the longer of which are orange at the base. Leg-plates orange. A pair of large squarish black dorsal patches on second incisure of the body, separated by a fine mid-dorsal line; smaller patches on the incisures in front and behind. Food, many shrubs and trees; including the walnut family, persimmon, sweet gum, and cotton. There is one brood, the moth flying in June.

Massachusetts to Illinois, Missouri, and south; rare northward. New York: Brockport, Utica, Lansingburg, Albany, Oak Hill, Clermont, Poughkeepsie, New Windsor, Peekskill, South Nyack, Staten Island, Long Island.

2. **C. sepulcralis** Grote and Robinson. Dull brown with a darker shade over the end of the cell and usually a small yellow spot at the base of the fore wing; hind wing with a little reddish shading. 75–100 mm. (**H 41**:5).

June; one brood. Caterpillar dull brown with irregular mottled oblique stripes on sides, and rather short orange horns, the front ones being little if at all longer than the caudal horn. Black spot on incisure of thorax smaller than in *C. regalis* and not divided. Food, pine (pitch and white).

Southern Maine and New York to Florida; very rare north of Florida.

2. *EACLES* Hübner

(*Basilona* Boisduval, *Dryocampa*)

Palpi smaller than in Citheronia, not at all projecting beyond the front; male antennæ with a couple more segments pectinate (about 20 in all). Fore wing with R_2 lost (fig. 420), middle discocellular right-angled at middle and relatively long, in some species longer than lower discocellular. Hind wing with R_1 lost. Female much larger than male.

1. **E. imperialis** Drury. Lemon yellow with diffuse dull-rose markings; antemedial line far out, strongly irregular, and excurved; postmedial line oblique, running to apex, on fore wing, and straight across hind wing. Discal spots annulate. Disc of thorax, tegulæ, and dorsum of abdomen largely dull rose. Wings with scattered blackish points. Male with considerable pinkish shading on basal part of fore wing, and a triangular area on outer margin, its upper half bounded by the postmedial line. Variety **punctatissima** Neumœgen is very heavily dusted with blackish, the dark dominating the yellow; race **didyma** Beauvois, from the Gulf strip, in the male has the yellow of the fore wing confined to a triangle resting on the middle of the costa, and the outer part of the hind wing brown; in the female, the base of the fore wing and outer part of both wings brown. The Texan race, **nobilis** Neumœgen, has a dark russet ground. ♂ 100, ♀ 150 mm. (**H 11**:13 ♂; **10**:2 ♀).

June; one brood. Caterpillar with sparse but long and conspicuous white secondary hair; spines about 3 or 4 mm. long, on second and third segments of body, and caudal horn, the others rudimentary. Color green, brown, or nearly black, the dark forms often with large russet patches about the spiracles; horns usually yellow, and anal and leg plates dusted and edged with yellow. Food, many trees, especially pine, maple, oak, cherry, cedar.

Ottawa, Canada, and south. New York: general from Peru southward.

3. *ADELOCEPHALA* Herrich-Schæffer

(*Sphingicampa* Walsh, *Othorene* Boisduval)

Imago practically indistinguishable from that of Anisota; average size a little larger, discal dot of fore wing, when visible, double; inner margin of fore wing, measured to tip of **A**, fully as long as outer margin. Hind wing shaded with deep rose in our species. R_1 free in the few specimens examined (fig. 421) but from extreme end of cell. Caterpillar entirely unlike that of Anisota, with a variable number of strongly flattened conical horns which are silvery on outer side, the two on the mesothorax not much longer than the others. Pupa smoother than that of Anisota.

* *Female antennæ bipectinate, wings blunter; pupa with hooked spines on shaft of antennæ* (Sphingicampa).

1. **A. bicolor** Harris. Dull ochre to fawn brown, dotted with blackish; usually with two superposed silver-white discal dots in a darker shade; postmedial line diffuse, running to costa about 3 mm. before the apex when distinct, sometimes hardly traceable. Hind wing crimson, shading into brown on outer margin, with a vague darker crimson postmedial band. Variety **immaculata** Jewett lacks the dark dusting — wholly in the female, and almost completely in the male. Variety **suprema** Neumœgen has the outer third of all wings and the body at least with ash-gray ground; the name is often used in error for a variant with more black dusting than usual. 60–75 mm., male usually smaller. (**H 10:** 5♂, 6♀.)

Caterpillar granulose, usually green with a bicolored lateral stripe, reddish anterior spines, and caudal horn, and a variable number of silver spines, usually developed on alternate segments; on locust and Kentucky coffee tree. Three broods, May; July; August; hibernating in pupa.

Mississippi Valley, north to Ohio and Iowa, a stray specimen taken in New Jersey. New York: (Grote, presumably from Buffalo).

** *Female antennæ simple, wings more pointed, pupa with blunt tubercles on shaft of antennæ* (Adelocephala).

2. **A. bisecta** Lintner. Fore wing ochre yellow, brighter than in *A. bicolor*, and never with a decided gray border; typically without any blackish dots, but well sprinkled in variety **nebulosa** Neumœgen. Inner line usually obscure, especially in male, outer strong, straight, pinkish, running practically to apex; discal dots small, white, or more often obsolete. Hind wing lighter ochre, heavily shaded with crimson; darkest in fold, with a faint postmedial shade or none. 55–75 mm.

Two broods— late May and July. Caterpillar similar to that of *S. bicolor*, but on the average with fewer spines; sometimes with very few (a few pairs on the thorax, two on the sixth segment of the abdomen, and the caudal horn); the spines of the thorax paler, the lower on the metathorax silvery; a brown and yellow lateral stripe. Larva social when young. Eggs very flat, laid in a cluster, browner than those of *A. bicolor*. Food Gleditschia.

4. *ANISOTA* Hübner

(*Dryocampa* Harris)

Similar to Adelocephala, with head a little more prominent, antennæ with about sixteen pectinate segments, simple in female; fore wing typically markedly triangular, with inner margin distinctly shorter than outer; but always more rounded in female, and in both sexes of *A. stigma* practically like that of *Adelocephala bicolor*, even less triangular than *A. bisecta*. R_2 lost; M_1, in the specimens exam-

ined, very shortly stalked (fig. 422). Hind wing more or less extended at inner margin, and sometimes lobed.

Larvæ (fig. 424) with long cylindrical subdorsal horns on mesothorax, in all stages, and with the other horns reduced to short spines or nodules, longest in *A. stigma*. Pupa very rough and spiny, with a strong serrate ridge across middle of segment eight of abdomen; formed in the ground.

The moths of the three latter species are not always distinguishable, but the larvæ are strikingly different.

Key to the species

(*Adult*)

1. No discal spot.....1. *rubicunda*.
1. A white discal spot.
   2. Males (antennæ pectinate).
      3. Fore wing opaque, and sprinkled with brown dots.....2. *stigma*.
      3. Fore wing translucent on disc, and not sprinkled.
         4. *senatoria*, 3. *virginiensis*.
   2. Females (antennæ simple).
      3. Fore wings translucent, not sprinkled with brown dots....3. *virginiensis*.
      3. Fore wings opaque, sprinkled with brown dots.....2. *stigma*, 4. *senatoria*.

(*Larva*)

Green .....1. *rubicunda*.
Yellow-brown .....2. *stigma*.
Pink and gray.....3. *virginiensis*.
Black and yellow.....4. *senatoria*.

I. *Moth without discal dot; larva with short spines, pupa with hooked spines on antennal shaft* (Dryocampa).

1. **A. rubicunda** Fabricius (Spiny maple worm). Bright straw yellow (nearly white in the western variety **alba** Grote), with broad diffuse pink ante- and postmedial lines, or (in the eastern form only) with the basal and outer thirds more or less completely filled with pink; hind wing with a slight pink postmedial shade, or wholly yellow. Male 40, female 50 mm. (**H 8**:11.)

One brood in the north (June and July), two broods southward (May and June; August). Caterpillar striped in two shades of green, with a pink subventral bar toward tail; spines black; feeding on maple, rarely in injurious numbers, occasional on oak. Just before pupation the caterpillar turns dark brown with obscure transverse banding.

Generally distributed, north to Quebec. New York: general.

II. *Moth with white discal dot; larva often with long spines; pupa with blunt tubercles on antennal shaft* (Anisota).

2. **A. stigma** Fabricius. Sexes nearly alike, but wings a little squarer in male. Bright ochre yellow, dotted with brown, often heavily; outer margin sometimes with a little gray-brown shading. Antemedial band obscure, postmedial straight, on fore wing running almost to apex, somewhat diffuse. Male 45, female 60 mm. (**H 11**:9 male, 10 female.)

One and two broods, the first in May and June. Caterpillar dull yellow-brown, granulated with white secondary tubercles, without distinct stripes; smaller spines strong, even on prothorax. Food, oak, and rarely, hazel.

Massachusetts to Ontario, Illinois, Kansas, and south. New York: Karner, Lansingburg, Poughkeepsie, Staten Island, Brooklyn. Records in this genus to be quite safe should be based on the larva.

3. **A. virginiensis** Drury. Male with outer margin of fore wing practically straight; of hind wing, normally distinctly concave; hind wing much longer on inner margin than on costa. Ground deep red-brown, often shaded with yellow-brown beyond middle of costa; disc of fore wing with a nearly transparent patch beyond the large white discal dot, clothed with widely spaced rudimentary scales. Postmedial line obsolete across the transparent patch, distinct toward the costa, antemedial line sometimes traceable. Postmedial line of hind wing below narrower, better-defined, passing well beyond the cell. Body deep yellow-brown. Female with M_2 and Cu_1 separate; fore wing translucent, ochreous, the outer margin of both wings and the base of the fore wing somewhat suffused with pinkish; postmedial line rather weak, discal dot often small. Male 40, female 50 mm. (H 8:9 male, 10 female.)

One brood in June. Caterpillar blackish, heavily dusted with cream-white tubercles; with two pairs of broad pink stripes; smaller spines nearly 2 mm., long in large part, but reduced to tubercles on prothorax. On oak.

Quebec to Minnesota and south. New York: Plattsburg, Buffalo, Lancaster, Ithaca, Salem, Albany, Staten Island, Brooklyn.

4. **A. senatoria** Smith and Abbot. Male practically like male *virginiensis*, normally with fore wing a little shorter, with more convex outer margin, somewhat less translucent disc, smaller discal dot, postmedial region of costa no yellower than the base and outer margin, and no trace of antemedial line; hind wing shorter, more rounded than in *A. virginiensis*, with nearly straight outer margin. Hind wing below with postmedial line more diffuse, crossing lower angle of cell. The range of variation of this species and of *A. virginiensis* seems to overlap. Female indistinguishable from female *A. stigma*, but on the average smaller, narrower winged, and with fewer brown dots; normally with M_3 and Cu_1 short-stalked. Male 40, female 50 mm.

One brood in June. Caterpillar on oak, sometimes on beech; black, striped with bright yellow, with black head; all the lesser spines reduced to tubercles less than 1 mm. long.

Quebec to Minnesota and south, rarer westward. New York: Karner, Bronxville, Staten Island; Yaphank, Long Island.

Family 39. SATURNIIDÆ

Moths large or very large, some exotic forms being almost the largest of known Lepidoptera. Body stout and heavy, but typically small in proportion to the enormous wings, relatively large in the Hemileucinæ. Vestiture hairy and dense. Antennæ plumose in male, in none of our species with simple apex; typically pectinate in female. Mouth parts much reduced, the tongue, when recognizable, usually too short to coil. Fore wing with M_1 free from R-stem in all the eastern species (stalked in the western genus Coloradia), typically closely associated with M_2; cell often open. Hind wing with **3d A** rudimentary except in Hemileuca. Egg with heavier shell than in the Citheroniidæ, usually somewhat rough. Larva with densely bristly spines, at least in younger stages, never with primitive first stage; tubercles **i** of segment eight of abdomen fused into a caudal horn in all our species, separate in Saturnia; **ii** of segment eight rarely developed into a spine; **ii** of segment nine fused on middle line only in the Hemileucinæ, which have subequal bristly spines and a smooth anal

plate. Pupa in a cocoon (except in Hemileuca), which is often complex in structure. Cremaster simple when present, often represented merely by a tuft of hooked setæ or absent; surface not spinose; metathorax without subdorsal tubercles, but often with a broad depression where it abuts on the wing. Abdominal segments frequently without flanges and telescoping when dried.

A large tropical family of very striking moths. Automeris is in many ways (save in the loss of **3d A**), the most primitive genus. Hemileuca is derived from nearly the same point, the others (Saturniinæ or Attacinæ) are more specialized and rather closely related. All but Hemileuca hibernate in the pupa.

1. *HEMILEUCA* Walker

(*Euchromia* Packard; *Saturnia,* in part)

Male antennæ singly bipectinate, of about 40 segments, female shortly pectinate, with about four simple joints at base. Vestiture of longer and looser hair than usual; fore tibia with a terminal claw. Abdomen usually slightly exceeding hind wings, with a terminal red tuft in male. Fore wing (fig. 416) with evenly rounded apex and outer margin, R_5 lost, upper discocellular short, but longer than middle discocellular, and longitudinal. **3d A** tubular, joining **2d A.** Hind wing with **3d A** more than half as long as **2d A,** normal, the wing crumpled next to body. Scaling thin, a mixture of forked and trifid scales and hair scales, making the wings translucent, especially in *H. lucina.* Markings characteristic.

Eggs laid in a large cluster (100) about a twig. Larvæ (fig 418) social and marching in procession when young, gradually scattering as they grow up, usually solitary in last stage. In all stages (except possibly when very small) with bushy branching spines tipped with nettling hairs, the two subdorsal rows on abdomen distinctly shorter than the others; and in the first stage each tipped with a long primary hair; mid-dorsal spines on both eighth and ninth segment of abdomen.

Our species both have a black ground color, with yellow dots at the bases of the secondary hairs, most of the spines black, but the subdorsal row mostly rust-red. In some specimens the light dots become confluent.

Pupa with flanges on anterior edge of movable segments, normally with cremasteral hooks, but pupating at the surface of the ground without forming any cocoon. Hibernation in the egg.

Sometimes pupæ go into hibernation and do not emerge until the following year.

1. H. maia Drury (Crape moth, buck moth). Smoky black, a cream median band, normally covering a third of the wings, but often narrow, and absent on the fore wing in ab. **lintneri** Packard. Discal spots large, black with central white lunules. Hind wing similar. Thorax and abdomen black, with very little or no white hair; posterior thoracic tuft and anal tuft of male red; collar partly yellow. 50–65 mm. .(**H 11**:1.)

Common locally on oak barrens, flying very swiftly by day in September and October. Caterpillar almost always on scrub oak, black, dusted with light yellow, the dusting heavier above and gradually fading out on the sides; dorsal tubercles largely black, but red at base. In the South a yellow form of the caterpillar seems to occur with the black concentrated into a subdorsal band, and contrasting red dorsal spines. Head red.

Massachusetts to Colorado and south. New York: Karner, Albany, and general on Long Island.

H. latifascia Barnes and McDunnough appears intermediate between *maia* and

lucina; it has the thin wings of *H. lucina* and the light band even broader, but is as large as normal *maia*, and looks somewhat suffused. Larva like *lucina*; apparently on willow. Manitoba; Wisconsin; South Dakota.

2. H. lucina H. Edwards. More translucent than *H. maia*, paler, the median band normally occupying fully a third of the length of the wings; the body with much white hair on the black portions. 50–60 mm.

Not rare in woods northward, replacing *H. maia*, and overlapping it in Massachusetts and Colorado. September. Caterpillar black, dusted with yellow, the yellow gathering into a broad stigmatal band, as in some southern larvæ of *H. maia*. Food, Spiræa. The larva has never been found on oak.

In aberration **obsoleta** Reiff, the pale band is interrupted on the fore wing, in aberration **lutea** it is yellower than usual.

2. *AUTOMERIS* Hübner

(*Hyperchiria* Hübner, *Io* Boisduval)

Fore wing with strongly arched costa, and, in our species, right-angled apex; hind wing rounded, slightly exceeding abdomen, at least in female. Male antennæ doubly bipectinate to apex, the outer pectinations rather shorter; female nearly simple. Palpi extending distinctly beyond the front, which is closer-scaled than in Hemileuca. No claw on tibia. Fore wing (fig. 415) with R_2 lost, upper discocellular short and oblique, middle discocellular transverse, but rather shorter than the weak and bent lower discocellular. M_1 and M_2 divergent. Hind wing with cell closed, **3d A** almost obsolete, as in the rest of the family. The moth rests with the wings folded in a triangle. A large genus in South America.

Eggs ovate, white, with a black spot at one end, laid in a flat cluster. Larva processionary when young, the families gradually breaking up, as in Hemileuca. Spines like those of Hemileuca in arrangement and structure; poisonous. Subdorsal spines rather longer than lateral; in stage 1, with a group of terminal setæ. Pupa flanged, in a thin cocoon of a single layer of rather brittle silk, between leaves on the ground. Hibernation in pupa.

1. **A. io** Fabricius (Corn emperor). Fore wing of male bright yellow, of typical female dull pinkish brown; antemedial line zigzag and outwardly oblique; postmedial line waved and nearly parallel to outer margin; both dark in male and in typical female. A dark brown discal bar, surrounded by a series of dark points, or the whole fused into an irregular patch; the female with more or less whitish scaling on the antemedial and postmedial lines, the base suffused with deep brown, and a dark shade along the postmedial line. Hind wing bright yellow, a little darker in female; a large blue ocellus on end of cell, centered with a white bar and encircled in a heavy black ring; a fine black postmedial line and a crimson subterminal band; inner margin broadly crimson. In the female variety **lutheri** Cockerell (*fusca* Luther, not Walker), which is dominant northward, the ground is deep purple, shaded with olive, with strongly contrasting greenish white ordinary lines and dots about the discal bar. In the Florida race, **lilith** Strecker, the ground of the fore wing is red in both sexes, and the hind wing orange. Under side yellow, shaded with crimson, with straight dark postmedial lines on both wings, and a large white-pupilled black ocellus on fore wing. Male aberration **argus** Neumoegen and Dyar has all the markings lost except the ocelli on the upper side of the hind wing and under side of fore wing. Male 60, female 80 mm. (**H 9**:4 male, 5 female.)

June to August, one brood. Caterpillar brown when young, with brown and black spines, becoming dull yellow and then green, in the later stages with a red and white stigmatal line. A general feeder. Cocoon brown, pupa black.

Common and generally distributed. New York: Wilmington and North Creek (Adirondacks), Buffalo, Ithaca, McLean, Oneonta, Albany, and south. One Ithaca specimen (male) is close to variety **lilith** Strecker.

3. *TROPÆA* Hübner

(*Actias,* in part; *Attacus,* in part)

Male antennæ very broad and plumose, doubly bipectinate, with equal branches; narrow, with alternate branches only half as long in female. Front with conical tuft, palpi distinct. Fore wing with arched costa, rounded apex, and somewhat concave, rarely scalloped, outer margin; hind wing with general form an equilateral triangle, but inner margin drawn out into a long twisted tail, supported by veins M_3, Cu and A. R_1 long-stalked (fig. 414) with R_{2+3}, R_2 distinct, R_4 shortly stalked. Upper discocellular rather short (unlike Actias), M_1 and M_2 strongly divergent, cell closed, the vein crossing a transparent spot. Hind wing with dorsal venation somewhat crowded, costal widely spaced; middle discocellular very long and longitudinal, as well as upper discocellular; cell closed like that of fore wing. Male abdomen rather small and conical in repose; female abdomen more cylindrical. Fore wings thrown back over hind wings in repose. The moth hybridizes with *Actias selene*, and the genera should probably be united.

Eggs laid in small groups, dark brown, blotched with white. First-state larvæ densely spinose, but with no unpaired spine on ninth segment of abdomen; green, rarely longitudinally striped with black; with black-barred head, secondary hair notably denser than in Telea; in later stages, body less humped than in Telea; turning dark brown immediately before pupation.

1. **T. luna** Linnæus (Empress, luna moth). Wing membrane bright green, partially covered with scales which are almost all bright yellow in male, largely white in female. Body white, a pinkish powdery band across collar, and on costa of fore wings, joined by a bar to discal ocellus; a waved crimson stripe on abdomen; fringes typically yellow. A black yellow, crimson, white, and transparent discal eyespot on each wing. The earlier spring specimens are variety **rubromarginata** Davis, and have the margins broadly edged with crimson, the costal stripe deeper red, and the postmedial line almost always distinct. The subtropical race **dictynna** Walker has shorter tails. 100 mm. (**H 12**:7.)

May and June; August. Caterpillar at first green with black and white head, later usually with green head (rarely reddish like *T. polyphemus*); each segment of body with a fine white line around the sides and back. Food walnut, birch, beech, and many other trees. Cocoon thin but tough, of a single layer of brown silk (heavier and white in *dictynna*).

Common and general, especially in wooded regions. Two broods (the second apparently partial). New York: Buffalo, Rock City, (Cattaraugus county), Ithaca, Trenton Falls, Oneonta, Schoharie, Albany, Saratoga Springs, New Windsor, Staten Island, Brooklyn.

4. *TELEA* Hübner

(*Attacus,* in part)

Male antennæ plumose, wider than in any other Saturniid, equally doubly bipectinate, female antennæ narrower than in Tropæa, with alternate pectinations vestigial, palpi minute. Body larger than in Tropæa. Fore wing with rounded, but strongly falcate apex. R_1 free, R_2 lost, upper discocellular very long, longer than in hind wing, and longitudinal, middle discocellular nearly obsolete. Hind wing with outer margin bent at middle, and often somewhat waved, apex often a little produced. Cells closed.

Eggs white, with a brown band around the edge, laid in small groups, Caterpillars (fig. 417) very strongly humped, hardly more than twice as long as high when at rest. Cocoon ovoid, densely woven of two firm layers with a little floss-silk between, without trapdoor; rarely, suspended by running a band of silk up to the stem along the petiole of one of the leaves in which it is enclosed, and

forming a ring about the stem; cocoon usually falling to the ground. The moth secretes a good deal of acid from the mouth before emerging, with which the silk is softened; and then cuts the silk with a hook developed out of one of the basal sclerites of the fore wing.

1. **T. polyphemus** Cramer. Grounds typically tawny yellow, dusted with blackish, but varying from cream color to olive or black-brown; outer margin and base rarely darkened. Collar and costa ash gray; antemedial line red and white, offset on **Cu**; postmedial line more than three-fourths way to margin, pinkish white, preceded by a blackish shade, and by a double black spot at costa; median shade faint, dark. Discal eyespot of fore wing with a good-sized hyaline center, ringed with yellow and finely with black; hind wing with a large black patch, enclosing the discal eyespot in its outer part; and largely filled with a blue shade; separated from the ocellus by a fine black line. Postmedial line heavier than in fore wing. Under side marbled in several shades of brown, quite unlike upper side; the wings folded over the back at rest. 125 mm. Dwarfs (down to 65 mm.), and giants (150 mm.) occur. (**H 9**:1.)

One brood in the north, in June and July; two southward. Caterpillar on maple, birch, and many other trees; translucent grass green, with pinkish head, more or less pinkish shining tubercles and thin slightly oblique whitish bars on sides. Young caterpillars have a darker brown head, and relatively longer spine. The color does not change before pupation.

Common and generally distributed. New York: Common everywhere in the State.

5. *CALLOSAMIA* Packard

(*Samia; Attacus,* in part)

Male antennæ plumose, the pectinations alternating in color, but scarcely in length; female antennæ about half as wide, with shorter pectinations also nearly as long as the longer ones. Mouth parts obsolete; male with very small body, female body large, but much shorter than the wings, which are strongly concave along the inner margin. Fore wing with rounded but produced apex, especially in male, and concave outer margin; hind wing produced at anal angle in male, margin rounded. Fore wing with R_2 preserved, R_1 free (fig. 413) upper discocellular very long, cell open, and M_1 and M_2 stalked in both wings. Wings folded over back at repose.

Eggs whitish, blotched with dull red cement, more rounded than in Telea and Tropæa. Larva, when young, as usual, with banded head; full-grown larva with two pairs of large blunt tubercles on meso- and metathorax, and one dorsal one on segment eight of abdomen; the others reduced to minute black points. Pupa nearly cylindrical, largely bright yellow-brown. Cocoon in a folded leaf, which is normally attached to its twig by enclosing the petiole and a short bit of the twig in silk. Cocoon proper oval, double, with a filling of floss silk between the two denser layers; each layer with a trapdoor at head-end of cocoon for emergence of moth, formed by a group of converging longitudinal loops of silk, which spring together again after emergence. The pupa rarely passes two years before emergence.

Key to the species

1. Outer margin bright ochre yellow; base of hind wing, below, largely rusty orange ..... 3. *carolina.*
1. Outer margin clay color; base of hind wing, below, reddish or blackish brown, without yellow tint.
   2. Fore wing, above, blackish; antennæ broader (males).
      3. Discal spots above large and angulate ..... 2. *angulifera.*
      3. Discal spots faint or absent ..... 1. *promethea.*

2. Fore wing above blackish or red-brown toward base, without decided yellow tint; pinkish red-brown in postmedial area.....1. *promethea* ♀.
2. Fore wing broadly shaded with ochre yellow, especially toward base. 2. *angulifera* ♀.

1. **C. promethea** Drury. Male nearly black, a little shining when fresh; postmedial region slightly paler; antemedial line lost; discal dot usually lost, or represented by a faint pale spot; postmedial line waved, fine, pale, a little more erect than outer margin; margin clay color, with a fine deeply waved black subterminal line; apical region, except beyond subterminal line, shaded with crimson; a waved oblique white apical line in cell R_3 and a large rounded black, brown, and blue eyespot in cell R_4. Hind wing similar, without the apical marks, with a chain of blackish spots before the subterminal line. Under side of fore wing similar, the postmedial area much paler, especially near the postmedial line, pinkish, and powdery. Hind wing with ground deep red-brown, the costa and postmedial space as in fore wing; discal bar often contrasting, but not large. Female with base of wings dull red, sometimes with a slight orange tint, shaded with blackish; antemedial line pale, defined with blackish, bent at a right angle over cell; postmedial line white, waved, preceded by a strong black shade; discal spot pale, edged with blackish, bar-shaped or angulate, not touching postmedial line. Postmedial region much paler, pinkish, and powdery; marginal marks like those of male; hind wing similar to fore wing, the dark blotches before the waved subterminal line dull red. Under side dull red, marked like male, the markings lightly defined with blackish, especially on fore wing. 75 mm. (**H 8**:3 ♂, 4 ♀.)

June to August, the second brood partial. Male flying by day, female by night, and not normally flying at all until after mating. Caterpillar on many trees, preferring sassafras and spicebush, wild cherry, and tulip tree. On hatching, yellow, with head and body heavily striped transversely with black; soon turning green. When full-grown, blue-green, somewhat pruinose, with the four thoracic humps red and the caudal one yellow, their bases ringed with black. No stigmatal line (**H 1**:2). Cocoon always suspended, twice as long as wide.

Common and generally distributed, north to Montreal, Quebec. New York: Buffalo, Ithaca, Elmira, Saratoga Springs, Albany, and common southward.

2. **C. angulifera** Walker. Pattern similar to *C. promethea;* male somewhat lighter umber brown, with strong angulate discal white spots on both surfaces; female heavily shaded with yellow, the angulate discal spots very large, and often crossing the postmedial line. Male as well as female nocturnal. (**H 11**:11 ♂, 12 ♀.)

Two broods, common southward. June; August. Caterpillar similar to that of *C. promethea;* when young, normally with head only striped, later with a clear yellow substigmatal stripe; on various trees, but especially tulip tree. Cocoon usually not attached to twig, and so falling to the ground with the leaves.

New England and south. New York: Buffalo, Ithaca (rare), Dutchess County, Staten Island, Brooklyn.

C. carolina Jones (*securifera* Maassen and Weymer?) approaches our southern boundary. The moth is suffused on both sides in both sexes with bright ochre yellow; discal spots of male small, as in *C. promethea.* Caterpillar like that of *C. promethea* in all stages; cocoon suspended, very large, the outer cocoon inflated and three times the diameter of the inner. Food *Magnolia glauca* only (refusing other Magnolias, but accepting tulip tree). South Carolina; Alabama; Florida (figured by Packard as *C. angulifera*).

6. *SAMIA* Hübner

(*Platysamia* Grote; *Attacus*)

Very close to Callosamia; larger, sexes alike, outer margin less concave; R_2 of fore wing lost; palpi recognizable. Egg like that of Callosamia (but larger); larva also similar, almost identical when young, but when mature with all the warts good-sized, rounded, studded with minute conical black setæ, which, on most of the warts, form rings about their tips; subdorsal warts of second to fourth segments of body more rounded, swollen, and tending to be discolorous; homologue of the caudal horn also swollen. Cocoon double, with a trapdoor at the anterior end, as in Callosamia, but fastened longitudinally to a twig; when first spun surrounded by an enclosure of leaves which soon weathers away.

1. **S. cecropia** Linnæus (Emperor). Body red, collar and abdomen striped with white; wings blackish, powdery, more or less shaded with red, lines and marginal markings about as in female *promethea;* antemedial line pale, defined with a dark shade; postmedial white, nearly even, preceded with blackish and followed by a wide red band; discal spots reniform, red and white, opaque; apical and marginal marks about as in *promethea,* but with less crimson at apex, and with some violet toward costa. Postmedial region blackish, with black spots along its outer margin. Under side similar, much more powdery, the costa of hind wing nearly white. 125–165 mm. (**H 8**:1.)

One brood in June. Caterpillar on many trees and shrubs: apple, elm, wild cherry, Spiræa, etc. When first hatched, black, gradually becoming red, orange, yellow, yellow-green, and apple-green, the color-changes not always occurring at moults. The enlarged warts are larger from the beginning. Full-grown larva with subdorsal warts of meso- and metathorax dull red, spotted with black cones, those on first segment of abdomen orange-yellow, the rest pale yellow; laterals all pale blue. (**H 1**:8). Skin grass-green in next to last stage, and the anterior warts scarlet, as in *S. columbia.* Cocoon fusiform, pointed at both ends, and usually with one or both ends attached to the twig; the outer cocoon sometimes much inflated, especially when spun on low shrubs. Silk reddish when fresh.

Generally distributed, north to Quebec. New York: general, not rare.

2. **S. columbia** Smith. Similar to *S. cecropia,* much duller, with red shadings reduced, body with a good deal of gray-brown; no red beyond postmedial line; discal spots on fore wing obscure or wanting; less red in apical region; ocellus usually with a small blue lunule only, and no brown, mostly black. Markings often suffused in northern specimens. 100 mm. (**H 8**:8.)

One brood, June and July. Caterpillar similar to that of *cecropia,* but grass-green in last stage, the anterior tubercles bright coral-red with black rings at their bases. Food, larch only. Cocoon ash gray, mottled with silvery streaks, more rounded than that of *cecropia,* and free at both ends. The western *S. nokomis,* described as a variety of this species, belongs more probably to *S. gloveri.* The western limit of the true conifer-feeding *columbia* is uncertain.

Southern New Hampshire to Michigan and northward.

7. *PHILOSAMIA* Grote

(*Samia; Attacus,* in part)

Near Callosamia and Samia. Female antennæ broader than usual; palpi slender and reaching front; fore wing with apex more produced than in Samia, fully as much as in male *promethea,* with outer margin sharply bent in above middle. R_2 very short, M_1 and M_2 hardly stalked, cells open, discal lunules transparent; hind wing long on inner margin, especially in male. Abdomen with three rows of small raised white tufts (in an exotic species with raised ridges).

Eggs relatively small, ovoid, without dark cement. Caterpillars as usual at hatching; when full-grown, with all the tubercles blunt, somewhat tapering, subequal, and of the same color (blue). Cocoon constructed like that of Callosamia, between two or three leaflets of the food plant, the sheathing of silk extending up the midrib of the compound leaf to the twig; cocoon more fusiform than that of Callosamia.

1. **P. walkeri** Felder. Olive (readily fading to yellow-brown); antemedial band white, running out on forks of **Cu**, and touching the discal lunule; postmedial white, with black before it, and a broad pink shade beyond, bent out at discal lunule, concave above and below; outer part of wing powdered, black and yellow or olive, shading into pink near apex. Apical eyespot small with a white crescent on its inner side; subterminal line close to margin and nearly even. Hind wing with postmedial line running to anal angle, and subterminal line preceded by a broader inner line. Discal lunules, starting from basal side, black, white, transparent, white, and yellow. Under side similar. (*cynthia* auct., not Drury). (**H 9:2** as *P. cynthia.*)

Caterpillar on Ailanthus; rarely straying to wild cherry and other *promethea* foods; at first green, with black head and tubercles; then yellow with pale head and tubercles; finally, light greenish with blue tubercles.

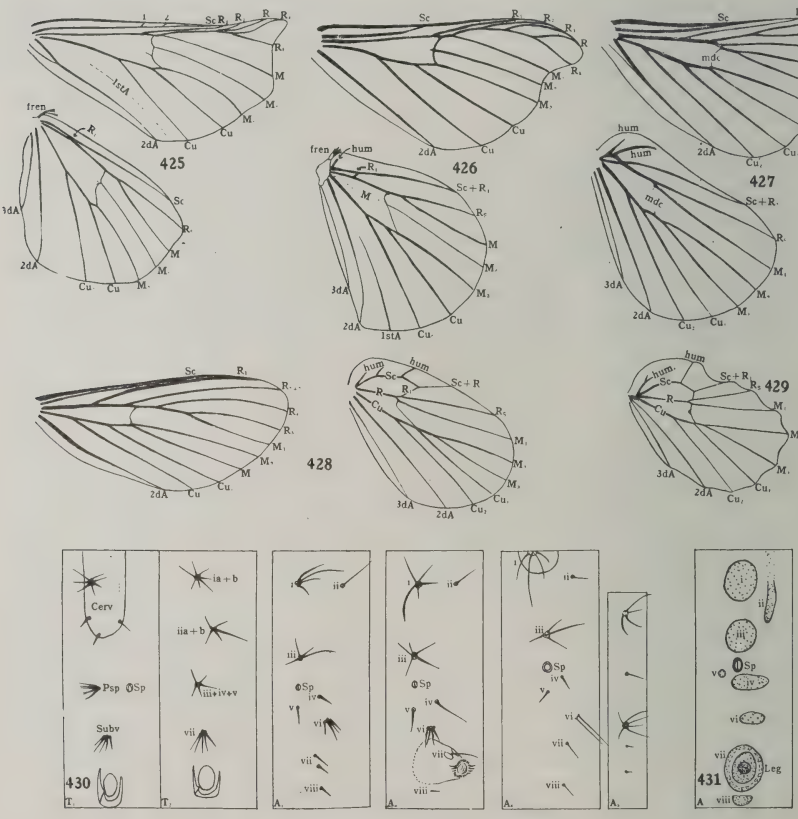
Sometimes several caterpillars spin on one leaf, and their cocoons have a common stem. The moth does not exactly match any of the described races of *P. walkeri*, and may have come from some not fully explored part of China, or be a domesticated mongrel form. It was originally introduced as a silk-worm.

Vicinities of New York, Philadelphia, and Washington, District of Columbia; introduced from the Orient. New York: Livingston, New York City, Staten Island, and vicinity.

SUPERFAMILY **BOMBYCOIDEA**

(Lasiocampina)

Heavy-bodied and usually medium-sized moths (a few exotic forms larger-bodied than most Saturniidæ). Head relatively small, retracted;



FIGS. 425–431. BOMBYCOIDEA

425, *Apatelodes torrefacta* (Eupterotidæ), venation (The figures **1** and **2** indicate accessory branches of **Sc.**); **426,** *Bombyx mori* (Bombycidæ), venation; **427,** *Malacosoma americana* (Lasiocampidæ) male, venation; **428,** *Heteropacha rileyana* (Lasiocampidæ), venation; **429,** *Epicnaptera americana* (Lasiocampidæ), venation of hind wing; **430,** *Bombyx mori* (Bombycidæ), seta map of first-stage larva, showing the characteristic arrangement of tufted setæ; **431,** *Chondrostega* (a primitive, Old-World Lasiocampid), showing arrangement of warts

front normally smooth, with a tuft of hair. Ocelli absent; mouth parts almost completely absent; only the palpi developed, and never large; clypeus sometimes inflated. Antennæ bipectinate, both sets of pectinations ventral; shaft somewhat irregularly but densely scaled above; pectinations often scaled. Female antennæ much narrower, but pectinate like those of male. Body with deep hairy or mixed vestiture, usually stout and woolly looking; abdomen large, often exceeding hind wings, and roughly cylindrical. Legs short, the femora and tibiæ densely hairy, and tarsi somewhat hairy; spurs generally normal. Wings most often broad, loosely and heavily scaled, with heavy veins. Fore wing with R_2 and R_3 stalked beyond their separation from R_4 and R_5 in the North American species; given off successively from R_{4+5} in Bombyx, and united in the Eupterotinæ. Accessory cell always absent, and R_3 and R_4 never stalked the farthest; M_1 often stalked with R_5 or R_{4+5}, M_2 variable in position; **1st A** lost, **3d A** sometimes distinct and running into **2d A** (Apatelodes). Hind wing in primitive forms with **Sc** and **R** closely parallel toward base, diverging before end of cell, and connected to **R** by a very distinct R_1, in Apatelodes (fig. 425) with R_1 lost, and the veins very closely parallel, in the Lasiocampidæ with the veins tending to withdraw in the higher genera; R_1 as strong as any vein, and far out toward end of cell; occasionally even short-stalked with R_s. M_2 as in fore wing. **1st A** lost, **3d A** normal. Wings folded triangular at rest, the costa of the hind wing uncovered in the Lasiocampidæ.

Egg normally of flat type; very thin and flat in Apatelodes; laid endwise in a cluster in Malacosoma. Larva with dense tufted and secondary hair (fig. 431), the tufts strong in stage 1 (fig. 430) where an additional subdorsal tuft is often distinctly developed, and **iv** and **v** form separate warts; later with tufts reduced and difficult to recognize; hair rudimentary in Bombyx. Many Eupterotidæ (including *A. angelica*) and also some primitive Lasiocampidæ, have scales as well as hairs. Front small, head with dense secondary hair, even on some or all of mouth parts. Prolegs normal, with a single band or biordinal hooks; often more or less spread out laterally. Skin thin and soft. Warts **i** of eighth abdominal segment often fused in a tubercle or caudal horn, very strong in Bombyx. Pupæ obtect, of normal macro type, varying in details in the families; typically enclosed in a dense silken cocoon. Cocoon cutter and fluid secretion normally as in Telea and its kin (p. 671).

Family 40. **EUPTEROTIDÆ**

(Lasiocampidæ, Notodontidæ, Bombycidæ, in part)

Head and body normal for the superfamily; thorax with a longitudinal crest in Apatelodes. Fore wing in the Apatelodinæ (fig. 425) with all veins preserved, $\mathbf{R}_2$ and $\mathbf{R}_3$, and $\mathbf{R}_4$ and $\mathbf{R}_5$ long-stalked; $\mathbf{M}_1$ very shortly stalked; $\mathbf{M}_2$ nearer **R**-stem than **Cu**-stem, the discocellulars transverse; $\mathbf{Cu}_2$ arising more than halfway out on cell. Hind wing in our species with **Sc** and **R** very closely approximate on basal third of cell, almost obliterating $\mathbf{R}_1$; frenulum normally developed; $\mathbf{M}_1$ short-stalked, $\mathbf{M}_2$ and $\mathbf{Cu}_2$ as in fore wing.

Caterpillar strongly flattened, with at least a few scales or hair scales; prolegs more or less stretched out laterally. Secondary hair (in our species) on mandibles, base of maxillæ, and labium, but not on distal part of maxillæ and labium, clypeus, or labrum. No caudal horn. Pupa resembling that of the Notodontidæ; maxillæ very short, the fore and middle legs meeting on the middle line behind them; abdomen finely punctate, with a row of beading on each movable segment; not clothed with fine setæ; second to seventh segments of abdomen with flange plates at anterior and posterior margins; cremaster short or absent.

Our single genus represents the Apatelodinæ, which are mainly South American; in the Eupterotinæ, of the Old World, $\mathbf{R}_2$ and $\mathbf{R}_3$ are completely united, **Sc** and **R** of the hind wing are more promptly divergent, and the frenulum is weaker.

APATELODES Packard

Palpi barely exceeding front (*torrefacta*), or moderate and upturned (*angelica*); fore wing subfalcate (fig. 425), with outer margin bent at middle and concave on upper half, costa nearly straight. Our species have one or two transparent subterminal spots.

1. **A. torrefacta** Smith and Abbot. Outer margin even. Pale gray, disc below costa and outer margin somewhat darker; lines fine, dark brown, continuous; antemedial excurved, postmedial bent out below costa and waved somewhat on veins; two fainter lines across median area; a brown patch on inner margin before **A**; rarely almost obsolete. Hyaline spot small and single. Hind wing red-brown, with a dark and pale postmedial shade parallel to outer margin and ending in one or two deep brown bars at inner margin. Upper side with a strong dark brown shade in cell. 35–40 mm. (**H 40**:20.)

The light form **floridana** H. Edwards with the spot on inner margin smaller and light chestnut brown, in place of black-brown, is commoner southward.

June and July. Caterpillar with dark body and fine and dense light yellow hair, with a series of small mid-dorsal black pencils, those on meso- and meta-

thorax and segment 8 of abdomen much longer. It feeds on many trees and shrubs.

New Hampshire to western Pennsylvania and south. New York: Kingston, Poughkeepsie, New Windsor, Greenwood Lake, Staten Island, Brooklyn and Lynbrook, Long Island.

2. **A. angelica** Grote. Outer margin scalloped, especially in female; thoracic crest stronger, palpi longer; usually with two hyaline spots. Pale powdery gray; ordinary lines reduced to blackish points on veins, the antemedial followed and the postmedial preceded by shaded brown lines; transparent dots finely edged with brown, with a vague brownish shade beyond them. No darker patch on inner margin. Hind wing browner, the base luteous, with dark median and postmedial shaded lines; outer margin brown. Under side pale, without dark shade in cell. 35 to nearly 50 mm. (**H 40**:21.)

May to July. Rarer than *A. torrefacta*. Caterpillar strongly flattened, gray, barklike, with a rough contrasting dark tuft on thorax, and the small dorsal pencils, but no long ones; on ash and lilac, resting on the bark.

Southern Maine to Texas. New York: Plattsburg, Bath, Sharon Springs, Albany, Poughkeepsie, West Point, Coldenham; Jamaica, Long Island.

The Chinese silkworm belongs to the family **Bombycidæ** (fig. 426, 430).

Bombyx mori Linnæus.

Moth mostly white, with falcate wings; R_1, R_2 and R_3 successively given off from stalk of R_{4+5}; M_2 nearly central in both wings; **Sc** and **R** somewhat divergent, even from the base, but R_1 placed well out and distinct; frenulum very weak. The moths have fully-developed wings, but fly little or not at all. Caterpillars white, strongly humped on thorax, with a more or less distinct lateral eyespot; with a strong caudal horn, and microscopic secondary hair. Cocoon dense, normally of yellow silk. The silkworm is occasionally cultivated in our territory, but is not known wild anywhere. Food black and white mulberry; it will also eat Osage orange, and will also feed, especially when young, on lettuce. (**H** p. 316 fl. 191–193.)

Family 41. **LASIOCAMPIDÆ**

(Bombycidæ, Lachneidæ)

Body and appearance about as in Apatelodes; normal. Spurs small. Fore wing normally with all veins preserved, R_2 and R_3 long-stalked, R_5 and M_1 more shortly stalked from end of cell, R_4 often arising out of the base of their stalk; M_2 from **Cu**-stem, middle discocellular vein long and angled. Cu_2 arising only one-quarter to one-third way out on cell. Hind wing without any trace of frenulum, with humeral angle broad and expanded, extending in front of fore wing at rest and supported by one or more well-developed humeral veins; **Sc** and **R** separate at base, then anastomosing or connected with **R**, forming a cell of variable size; M_2 arising from **Cu**-stem, Cu_2 attached rather before middle of end of cell, not so near the base as in the fore wing.

Eggs, when laid singly, with micropyle on side, ovate; eggs of Malacosoma clustered in a ring about a twig, such egg being laid on the previous one so that the micropyle is at the exposed end; the whole

mass covered by a sort of varnish. Caterpillar (fig. 431) very hairy, with dense secondary hair on all parts except tips of palpi, even on antennæ. (Some primitive forms are like Apatelodes.) Form varying from nearly cylindrical (*M. americana*) to very much flattened, with lateral lappets on segments (*Tolype* and *Epicnaptera*). Notch of labrum not so deep as in Apatelodes. Pupa in a cocoon, which is dense except in *M. disstria*; more or less densely clothed with secondary hair; palpi well exposed; no cremaster; fore femora covered, and maxillary palpi absent. Epicranial suture distinct.

Key to the genera

1. Humeral cell of hind wing about as large as discal (fig. 429).
   2. Fore wing with all veins preserved; wings very irregular....4. **Epicnaptera.**
   2. Fore wing with R_2 and R_3 completely united; wings nearly even (fig. 428). **5. Heteropacha.**
1. Humeral cell small and inconspicuous.
   2. Outer margin of fore wing distinctly concave at middle; cell of hind wing open (fig. 427).....3. **Malacosoma.**
   2. Outer margin of fore wing evenly rounded; cell of hind wing closed.
      3. Thorax with even hair.....2. **Artace.**
      3. Thorax with a strong median crest of metallic scales.....1. **Tolype.**

1. *TOLYPE* Walker

Body very stout and long, with dense woolly vestiture, looser on tegulae; disc of thorax clothed with shining spatulate hairs; end of abdomen with a loose terminal tuft. Fore wing evenly rounded; cell scarcely two-fifths its length; R_4 short-stalked. Hind wing rounded, with small humeral cell, and a single long humeral vein, curved out at tip; the other veins arising from the cell.

Eggs laid in a row, covered with hair from the abdominal tuft. Caterpillar strongly flattened, with lateral lappets, and well-marked subdorsal warts; those on eighth segment of abdomen not enlarged. Cocoon dense, strongly flattened; on bark. Pupa with secondary setæ very weak; cremaster indicated by an abrupt narrowing of the end of the last segment.

Key to the species

1. Smoky gray, the markings nearly obsolete, except for the pale subterminal line .....2. *laricis* ♂.
1. Markings sharply defined, in two shades of gray, or in gray and white.
   2. Subterminal band dark gray, contrasting with the whitish base and median area .....2. *laricis* ♀.
   2. Median area dark, concolorous with the subterminal band.....1. *velleda.*

1. T. velleda Stoll. Head and thorax white, abdomen gray, disc of thorax and sometimes base of abdomen contrasting, blackish. Fore wing ash gray, with white veins, and fine, waved, white, ordinary lines, the transverse anterior and transverse posterior often double; terminal line white, followed by gray bars in the fringe. Base, margin, and filling of lines sometimes pale. Hind wing with vague bands. 30–50 mm. (**H 11**:7 ♂, 8 ♀.)

Caterpillar gray, finely and obscurely striate, with a dorsal pair of warts on metathorax and a narrow black band between thorax and abdomen, concealed at rest; on apple, poplar, and other trees.

Montreal, Quebec, to Pennsylvania and Michigan. New York: Spier Falls, Rochester, Lancaster, Buffalo, Ithaca, Oneonta, Albany, Bronxville, Staten Island; Southold and Bellport, Long Island.

2. **T. laricis** Fitch. Male deep smoky gray; head and collar usually white, contrasting; fore wings with traces of the markings of *velleda*, but usually with only the waved whitish subterminal line distinct; veins dark. Female white, with several more or less distinct waved gray bands across basal two-thirds of fore wing; subterminal space broadly ash-gray, terminal space paler gray, separated from it by the wavy white subterminal line. Veins wholly white. Hind wing shading into gray on outer half. ♂ 25, ♀ 30 mm.

Caterpillar dull brown, similar to *velleda*, but with the warts on the fifth segment of the abdomen stronger than those on the metathorax; on larch. Occasional transitional specimens occur, suggesting that the species may hybridize.

Distribution with *T. velleda*, but more local. New York: Plattsburg, Rochester, Coldwater, Buffalo, Bath, Ithaca, Albany, Poughkeepsie.

2. *ARTACE* Walker

Similar to Tolype, but without the metallic hair on the disc of the thorax. Caterpillar less flattened.

1. **A. punctistriga** Walker. White, with the usual lines represented by four or five rows of black dots on veins of fore wing. 25–35 mm. (**H 12**:5.)

Caterpillar gray, mottled, with an orange transverse band behind thorax, and a distinct raised lappet on dorsum of eighth segment of abdomen, only.

New York and south; west to Mississippi Valley and Arizona. New York: Brooklyn (Ottolengui).

3. *MALACOSOMA* Hübner

(*Clisiocampa*)

Body less loosely hairy than in Tolype, without any central thoracic tuft. Fore wing bluntly rounded (fig. 427), much longer in female than in male, the slight concavity of the outer margin nearly evened up by the fringe; R_1 free, M_1 only very shortly stalked. Hind wing with very small humeral cell, bearing 2 humeral veins. Caterpillar cylindrical (*americana*), or slightly flattened (*disstria*), without lappets or distinct enlarged tubercles; social. Cocoon double, the inner cocoon with the interstices filled with yellow powder.

Key to the species

Two transverse white lines across wing.....1. *americana.*
Two pale lines toward costa, dark lines, or none.....2. *disstria.*

1. **M. americana** Fabricius (Tent caterpillar). Brown (walnut brown of Ridgway) with two white lines, trisecting the wing, fringe cut with white, most distinctly in the male. Median area sometimes paler, or base with whitish suffusion. ♂ 25 ♀ 35 mm. (**H 10**:12.)

Very common and general in distribution, often injurious to apple; also on wild cherry and other Rosaceæ. When very common, it will eat almost any deciduous tree, but then usually dies before maturity. The caterpillars form a conspicuous tent of silk in the fork of a branch, enclosing no leaves, and feed

outside. Eggs in a belt around a twig, the belt more than twice as long as wide (unless dwarfed in some way). Caterpillars mottled and striped with blue, tawny yellow and black, with a continuous white dorsal line. Cocoon dense, of white silk filled with yellow powder, the inner cocoon opaque and outer very slight; usually formed at a distance from the food; but in captivity, often in the tent.

New York: Common throughout the State.

2. **M. disstria** Hübner (Forest tent caterpillar). Light grayish brown; typically, with two brown lines replacing the white ones of *M. americana*. In variety **sylvatica** Harris, the median third is contrasting dark brown; variety **thoracicoides** is practically immaculate, with traces of pale lines; in variety **perversa** Neumoegen and Dyar the base and outer margin are darker than the median area; aberration **astricta** Reiff is immaculate straw yellow, and aberration **anita** Reiff chocolate brown, with traces of pale lines. 20–37 mm., female larger (**H 10**:9.)

Caterpillar living in a colony on the trunk or a large branch of the food tree, but spinning only a slight carpet; pale grayish blue, with fine orange and black lines, and a dorsal stripe broken into a series of cream-yellow spots; normally with a larger and a smaller one on each segment. Outer cocoon relatively strong, and inner light, translucent, with only a little yellow powder; often spun on the food plant. Food, forest trees, especially maple; often injurious.

Common and general in distribution; a variant form on the Pacific Coast. New York: Common throughout the State, even on the top of Mt. Marcy. I have seen variety *sylvatica* from Ithaca, Geneva, and Peru, and variety *thoracicoides* from Peru.

4. *EPICNAPTERA* Rambur

(*Gastropacha; Phyllodesma,* in part)

Palpi moderate, longer than in the preceding genera; vestiture closer; fore wing with margin scalloped and deeply notched at anal angle; R_4 hardly stalked (fig. 429); hind wing scalloped and deeply notched on costa, humeral cell as large as discal; two humeral veins, one from point of separation of **Sc** and **R**, and the other well out; R_1 long, transverse, arising from **R** after its separation from cell, M_2 and M_3 short-stalked; caterpillar much like that of Tolype, without enlarged warts in our species; two transverse red bars on incisures of thorax, each marked with three black dots, and concealed at rest. Cocoon on bark, flattened like Tolype. Pupa bluntly rounded at rear, less hairy than that of Malacosoma, but more so than in Tolype.

1. **E. americana** Harris (American lappet). Bright brown, shaded with dark brown and frosted with white, resembling a crumpled dead leaf. Veins rather darker; transverse anterior and transverse posterior lines dark, irregular, and quite incomplete or waved on veins, followed by the whitish shades. Summer form **ferruginea** Packard much redder; the ground nearly even, with some white scaling, but no contrasting pale shades. ♂ 30, ♀ 45 mm. (**H 41**:19 ♂ 20 ♀.)

Not common. Caterpillar mottled, dark gray, on apple, oak, maple, and other trees; resting on the bark by day. Two broods; moth in May and early June; July and August.

Generally distributed; a slightly variant race in the west. New York: Old Forge, Rochester, Lancaster, Buffalo, Ithaca, Oneonta, Rhinebeck, Poughkeepsie, Long Island. I have seen variety *ferruginea* from Ithaca and Karner.

5. *HETEROPACHA* Harvey

Similar to Epicnaptera, but with the margins nearly even (fig. 428), the anal angle of fore wing not notched, and the costa of the hind wing evenly rounded; fore wing with R_2 lost, R_4 strongly stalked, hind wing with three humeral veins; two arising from the very large humeral cell.

1. **H. rileyana** Harvey. Dark ash gray, powdery and mottled, the median area rather darker, bounded by wavy and often obsolete wavy pale and dark transverse anterior and transverse posterior lines; subterminal of dark dots; fringe checkered. 30 mm. (**H 8**:7.)

Caterpillar much like that of *E. americana*, but without any wart on eighth segment of abdomen.

Western Pennsylvania to Kansas and south; Florida.

SUPERFAMILY **DREPANOIDEA**

Ocelli and maxillary palpi absent; tongue not scaled, variable in strength, absent in Oreta; antennæ normally deeply prismatic, rarely slender or pectinate, sometimes with very little scaling on shaft; palpi small or moderate. Body relatively small and stout, stumpy looking, appearing larger in the Thyatiridæ on account of the deep vestiture, abdomen broadly attached to thorax, legs rather weak. Tergopleural groove of basal segment of abdomen much enlarged, opening into a large cavity covered by a lateral chitinous area representing the tympanic structures; our species also with a chitinized subventral bulla at the base of the abdomen, divided in two parts; thorax not modified. Fore wings typically with a long slender accessory cell, lost in a few exotic forms; sometimes with $\mathbf{R}_2$ and $\mathbf{R}_3$, $\mathbf{R}_4$ and $\mathbf{R}_5$ separately stalked together, $\mathbf{R}_1$ free, and all radials present. $\mathbf{M}_2$ variable in position; in our species always at least twice as near $\mathbf{M}_3$ as $\mathbf{M}_1$ in the hind wing and often in the fore wing; **1st A** wholly lost, **2d A** and **3d A** normal. Hind wing with $\mathbf{R}_1$ obsolete at extreme base of wing, **Sc** and **R** closely parallel to well beyond end of cell, or anastomosing beyond end of cell; humeral angle sometimes expanded, and frenulum occasionally lost; **1st A** lost, **2d A** normal, **3d A** often very weak. Base of **Sc** much swollen in Oreta.

Egg of flat type; larva with hooks of prolegs biordinal, except in Eudeilinea, normally with a few outer hooks also. Front small; head more or less bilobed, and often decidedly wider than high, with primary setæ only. Body with a few subprimaries, sometimes with only **vi** duplicated; in other forms with a few subdorsal warts; **vii** composed of two or more setæ on the meso- and metathorax (unlike the simple-haired members of the Noctuidæ and related families). Ventral prolegs equal, anals somewhat reduced, and raised at rest (Thyatiridæ, Brahmæidæ), or absent (Drepanidæ). Pupa not well known, thin-skinned, in *Oreta rosea* cylindrical, tapering very abruptly at posterior end; no sutures on head; prothorax of macro type, broad and rounded out; labial palpi showing as a minute area at base of tongue, which is about a third the length of the wing (doubtless longer in other genera); femora covered; fore and middle tarsi meeting on middle line (probably a merely generic character); antennæ shorter than middle legs, filiform; and neither middle legs nor antennæ reaching tip of wings. Tips of hind tarsi exposed; some rudiments of abdominal spining; cremaster rudimentary, without setæ. Setæ indistinct.

The superfamily on the whole is an isolated member of the general Bombycid-Saturniid series, but not especially close to any particular group; the likeness to Geometridæ, Notodontidæ, and Noctuidæ being mostly superficial, or due to the persistence of primitive characters. They may possibly be nearest the Geometridæ. The Oriental genus Euchera connects the two families. Besides the two North American families, the Brahmæidæ also appear to belong to the same stock.

Family 42. THYATIRIDÆ

(Cymatophoridæ)

North American species with deeply laminate antennæ, tongue developed but not very strong, and moderate palpi; deep hairy or mixed vestiture, with a truncate tuft, or rather, mass of hair-scales, on disc of thorax, and hairy legs. Abdomen with small dorsal tufts. Fore wing with R_1 free, R_2 from accessory cell near tip, R_3 and R_4, or R_4 and R_5 shortly stalked from tip of accessory cell; in the latter case, with the cell closed by a crossvein, **r**. Accessory cell extending nearly halfway to apex; M_1 normally from it, M_2 from middle of end of cell; both middle and lower discocellular veins weak and bent; **3d A** distinct. Hind wing with middle discocellular at least twice as long as lower discocellular, and bent; **3d A** well developed; frenulum strong, and, in the male, knobbed at tip.

Caterpillar (fig. 434) with head decidedly wider than high, labrum deeply notched, **vi** on abdomen represented by two well-separated setæ; **vii** of 3 setæ on leg-bearing segments, and 2 or 3 on the other segments of abdomen. Seta **iv** higher than spiracle, sometimes almost directly over spiracle and close to **iii, v** normally associated with one or two subprimaries. Prolegs sometimes with rudimentary outer hooks. The caterpillars live in a loosely rolled leaf. Pupa not studied.

A small family, formerly usually placed with the Noctuidæ or Notodontidæ, which the species resemble superficially. In the Old World, forms occur with M_2 either low or high in both wings, but otherwise typical, even in pattern.

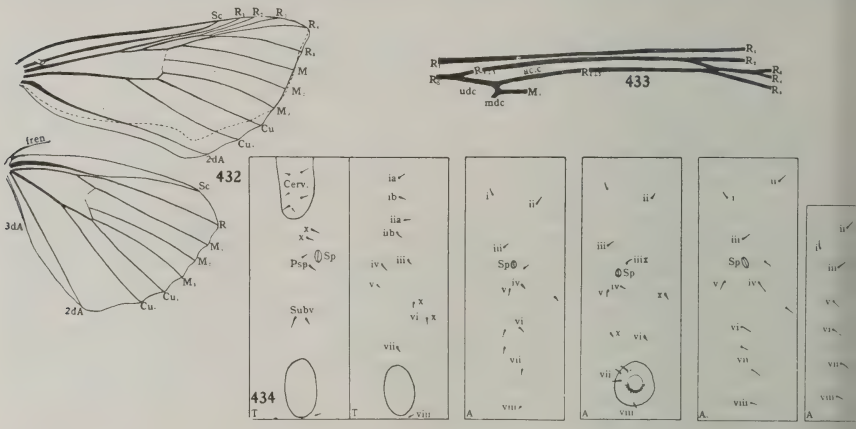
Key to the genera

1. Fore wing with a tuft a third way out on fold; R_3 and R_4 shortly stalked from accessory cell (fig. 433) ..... 3. **Euthyatira.**
1. Fore wing smooth-scaled; R_4 and R_5 shortly stalked from accessory cell, R_3 free (fig. 432).
2. Fore wing with anal tuft; more than twice as long as wide. 2. **Pseudothyatira.**
2. Fore wing without anal tuft; hardly twice as long as wide .... 1. **Habrosyne.**

1. *HABROSYNE* Hübner

(*Thyatira*, in part)

Fore wing about twice as long as wide, with a slight anal lobe and tuft; accessory cell relatively short, closed by crossvein **r**; M_1 arising from accessory cell; wing smooth-scaled; hind wing with M_2 about twice as near M_3 as M_1, (Figs. 432, 433.)



FIGS. 432–434. THYATIRIDÆ

432, *Habrosyne scripta*, venation. (The form of the fore wing of Pseudothyatira is also shown in outline); **433,** *Euthyatira pudens*, accessory cell of fore wing, showing connections of neighboring veins; **434,** *Habrosyne derasa* (Europe), seta map.

Caterpillar mottled, dead-leaf brown, with dark dorsal line and rather smooth head, the dark dorsum sharply set off from the pale venter.

1. **H. scripta** Gosse. Light gray-brown. A large smooth brown patch toward base, below **Cu**, its upper boundary sharp, along **Cu**; inwardly, with a sharp oblique boundary from **Cu** to **A**, then shading into base; outer boundary outwardly oblique from **Cu** to **A**, and only a little indented; then inwardly oblique to inner margin; patch outlined with pinkish white, expanding into a large triangular area on cell and costa, but leaving base dark. A group of faint oblique striæ across middle of cell, followed by the oblong dark, pale-outlined orbicular and reniform spots. Transverse posterior line deeply but roundedly waved; of three or four parallel deep-brown lines, not reaching costa; a broad curved pale subterminal shade from apex to anal angle, with a dark shade before it toward costa; middle of costa pale. Hind wing clay color, with shaded postmedial and outer bands. 30–35 mm. (**H 40**:22.)

June. Caterpillar with dull, slightly rugose head; on blackberry, thimbleberry, and other Rosaceæ.

New Jersey to Alberta; north to Gaspé and Alaska. New York: Plattsburg, Peru, Essex County, Lake Pleasant, Evans Center, Rock City (Cattaraugus County), Ithaca, Big Indian Valley, Onteora Mt., Schenectady, Poughkeepsie, Brooklyn.

2. **H. rectangula** Ottolengui. Outer boundary of sub-basal patch starting perpendicularly down from **Cu**, and then right-angled; inner boundary also more perpendicular. Ground darker brownish gray; pale patches above antemedial patch, and at middle of costa, more decidedly pinkish.

Caterpillar similar to that of *H. scripta*, with shining head.

Maine; New York; Pennsylvania; Illinois; Rocky Mountains; a paler race in Arizona. New York: Brooklyn (type).

2. *PSEUDOTHYATIRA* Grote

Accessory cell closed by a short crossvein **r**, running from R_3 to stem of R_{4+5}, as in Habrosyne. Similar to Habrosyne, but with the fore wing relatively longer, with a stronger tooth and tuft at anal angle, and costa more arched. Caterpillar similar, but with the brown dorsum shading gradually into the paler venter.

1. **P. cymatophoroides** Guenée. Ash gray, somewhat mottled and shaded with pink in antemedial region and over end of cell; base typically blackish; transverse anterior line of a group of three waved blackish lines; transverse posterior of a similar series of waved lines, more sinuous, and blackish only at costa; with a blackish patch beyond it on inner margin, preceded by a white line; a dark patch on costa before apex, crossed by a white lunule; subterminal line of small, wedge-shaped marks between the veins. Orbicular circular; reniform oblong, both small; with raised central dark dots and gray rings; fringe pinkish. Hind wing pale brownish gray. 42 mm. (**H 40**:25.)

Variety **expultrix** Grote is similar, but lacks the blackish shades, the antemedial group of lines being light gray, and the hind wing rather darker gray. (**H 40**:26.)

June to August. Caterpillar often with one or a series of lateral white spots, especially in the type form; on oak and thimbleberry.

Generally distributed; the variety rather commoner than the type. New York: Wilmington (larva), Newcomb, Plattsburg, Mt. Marcy, Fentons (Lewis County), Clayton, Lancaster, Otto, Ithaca, DeBruce, Sharon, Schenectady, Poughkeepsie, Staten Island, Newtown, Long Island. Form *expultrix:* Plattsburg, Fentons (Lewis County), Mt. Marcy, Newcomb, Clayton, Buffalo, Lancaster, Otto, Rock City, Ithaca, Sharon, Schenectady, Long Island.

3. *EUTHYATIRA* Smith

(*Thyatira,* in part)

Fore wing rather long and narrow, with arched costa, without a scale tuft at anal angle; hind wing longer on costa; accessory cell formed by the anastomosis of R_2 and R_4 (fig. 433); a well-marked tuft on fold before transverse anterior line, but no tufts on orbicular and reniform spots.

The caterpillar lives concealed in a loosely folded leaf; it is translucent, with four black spots on the head.

1. **E. pudens** Guenée. Gray, with large pink spots, the basal one large and oblong, with the tuft in its outer end; a large one on middle and one at apex of costa, and a smaller and browner one at anal angle. Orbicular horizontally elongate, small, touching reniform, both pink-filled; the other markings obscure. 45 mm. (**H 40**:23.)

Variety **pennsylvanica** Smith (**H 40**:24) from western Pennsylvania, is wholly

ash-gray, with inconspicuous markings; in variety **anticostiensis** Grote, from Anticosti and the neighboring mainland, the pink spots are reduced, and the ground strongly hoary.

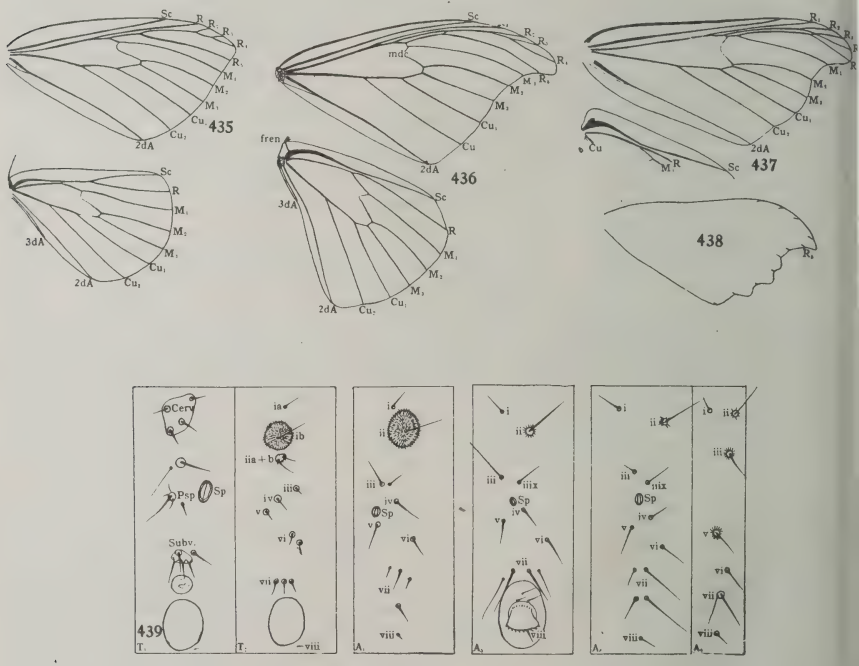
Caterpillar on cornel. Moth in May.

Newfoundland to West Virginia and British Columbia. New York: Brockport, Lancaster, Ithaca, Dutchess County. I have not seen the variety *pennsylvanica* from the State.

Family 43. **DREPANIDÆ**

(Drepanulidæ; Platypterygidæ; with Auzatidæ)

Slender broad-winged moths, similar to Geometridæ, but distinguished from them by the stumpy body. Male antennæ often pectinate; palpi



FIGS. 435–439. DREPANIDÆ

435, *Eudeilinea herminiata*, venation; **436,** *Drepana arcuata*, venation; **437,** *Oreta rosea*, venation, showing only costa of hind wing; **438,** *Falcaria bilineata*, outline of fore wing; **439,** *Drepana falcataria* (Europe), seta map of larva

minute in our species; tongue weak or absent. Fore wings normally with falcate apex; with accessory cell very long and slender, closed by the anastomosis of R_3 and R_4; M_2 well separated from M_3, but distinctly arising from Cu-stem in both wings; M_3 and Cu_1, separate; Cu_2 arising well out on cell. Hind wing with humeral angle enlarged, frequently supported by a short but distinct humeral vein; frenulum more or less reduced, or lost; humeral vein distinct in fore wing.

Caterpillar (fig. 439) with more secondary hair than in the Thyatiridæ, ventrally, but none dorsally except on the few enlarged tubercles; normally with hair-like skin granulation. Ventral prolegs normal, with rudimentary outer hooks; anals completely lost; a tubercle or spine on anal plate.

There are two broods a year, often differing in color.

Key to the genera

1. Fore wings blunt; hind wing with Sc and R anastomosing (fig. 435). ..... 1. **Eudeilinea.**
1. Fore wings falcate; Sc and R of hind wings separate.
2. Outer margin dentate (fig. 438) ..... 3. **Falcaria.**
2. Outer margin even.
3. Frenulum and tongue lost ..... 4. **Oreta.**
3. Frenulum and tongue preserved ..... 2. **Drepana.**

1. *EUDEILINEA* Packard

(*Corycia*, in part)

Antennæ simple, laminate. Fore wing blunt (fig. 435), oblong with arched costa, translucent. No accessory cell. Hind wing with Sc and R anastomosing, female frenulum distinct, of many bristles. Larva with a mere tubercle on supra-anal plate; with uniordinal hooks.

1. **E. herminiata** Guenée. White; some blackish on legs; normally with ante- and postmedial series of grayish points. Two discal points, obliquely placed, on each wing, below. 28 mm. (*biseriata* Packard).

May and June; July and August. Caterpillar on cornel.

Generally distributed. New York: North Elba, Fourth Lake, Fulton Chain, Newcomb, Batavia, Oak Orchard Swamp, Otto, Potter Swamp and Crosby (Yates County), Taughannock Falls, Ithaca, Big Indian Valley, Nassau, Albany, Rhinebeck, New Windsor, Staten Island.

2. *DREPANA* Schranck

(*Platypteryx* Laspeyres)

Fore wing falcate (fig. 436) below R_4, with evenly sinuous outer margin; R_2 long-stalked with R_{3+4}; M_1, arising separately from cell, hind wing with Sc and R closely approximate beyond end of cell; humeral angle moderately enlarged, with a weak but distinct frenulum; 3d A rudimentary. Antennæ pectinate, narrowly in female; palpi minute, tongue well-developed.

Caterpillar (fig. 439) with a caudal process about as long as head, with subequal hairy warts on meso- and metathorax and second segment of abdomen, and minute ones on eighth segment.

1. **D. arcuata** Walker. Typically cream-white, the area before the postmedial line with fine brown wave lines; postmedial in a smooth curve from just beyond middle of costa to apex, then in an even curve to outer third of inner margin, with a blackish shade below it at apex; discal dot fine, black. Hind wing similar toward inner margin, pale on costal half. Summer form **genicula** Grote (**H 41**:22), straw yellow, and less strongly striate, the upper leg of the postmedial line often lost. 30 mm. (**H. 41**:23.)

The forms are not entirely seasonal and intergrade.

May and June; August. Caterpillar on birch and alder.

Pennsylvania to Indiana and north. New York: Plattsburg, Peru, Old Forge, Mt. Marcy, Lewis County, Lancaster, Ithaca, McLean, Trenton Falls, Rhinebeck, Big Indian Valley, Poughkeepsie, New York City, Staten Island; general on Long Island.

3. *FALCARIA* Haworth

(*Edaptera* Packard; *Drepana*, in part)

Similar to Drepana, but with the outer margin regularly scalloped (fig. 438), the deepest scallops on Cu_1 and Cu_2 (not as usual between veins); and hind wing slightly waved. Caterpillar with strongly enlarged warts on meso- and metathorax and on eighth segment of abdomen; caudal process about as long as the height of the head.

1. **F. bilineata** Packard. Typically cream-white, heavily striate with brown (in the late-summer variety **levis** Hudson, bright yellow and hardly striate); with two parallel and nearly straight oblique brown lines, the outer cutting the lower angle of the cell; discal dot minute. 28 mm. (**H 41**:7.)

Caterpillar on birch.

New Jersey and north. New York: Plattsburg, Wilmington, Albany, Brooklyn, Staten Island. Variety *levis* Hudson is known definitely from Plattsburg, Wilmington, Alpine, Saratoga, Westchester County, and Brooklyn.

4. *ORETA* Walker

(*Drepana*, in part; *Dryopteris*)

Eyes relatively large; palpi rudimentary; tongue invisible; antennæ deeply laminate, not pectinate. Fore wing falcate (fig. 437), extreme apex rather blunt, on R_4; outer margin more abruptly notched below it. R_2 arising from the accessory cell, which is extremely long; hind wing without frenulum, with a rudimentary humeral vein arising from the much-thickened base of **Sc.**

Caterpillar with a prominent unpaired hump on metathorax; caudal process twice as long as head. Pupa as described in the superfamily, showing the short tongue and large eyes. The two nominal species are doubtfully distinct.

1. **O. rosea** Walker. Pinkish or purplish brown, striate with darker brown, out to postmedial line; subterminal region bright yellow; outer margin dark brown; hind wing with outer third yellow and only apex dark brown; antemedial line obscure, darker, distinct, and parallel to postmedial on lower part of wing; postmedial from three-fourths way out on costa, acute-angled on costa, and then oblique in, to two-thirds way out on inner margin. Subterminal line sometimes indicated by blackish dots. Under side similar. Variety **marginata** Walker is

yellow, except for the dark brown border, and intergrades with the type form. 25–35 mm. (**H 41**:24.)

May to September; two broods. Caterpillar on Viburnum.

New Jersey to Ohio and north. New York: Peru, Fentons (Lewis County), Mt. Marcy, Ithaca, Big Indian Valley, Albany, Rhinebeck, Poughkeepsie, Staten Island, Brooklyn. I have seen variety *marginata* Walker from "New York City and vicinity" (Eliot), and a transitional specimen from Ulster County.

2. **O. irrorata** Packard. Ground wholly strigose dull brown or brownish crimson, without any yellow; markings as before, the postmedial sometimes double or almost obsolete. 25–35 mm. (**H 41**:6.)

With the preceding form, but apparently much rarer and local.

Massachusetts and Pennsylvania to Manitoba. New York: Mt. Marcy, Ithaca.

Memoir 66, *Simplified Apparatus and Technique for the Electrometric Determination of Hydrogen Ion Concentration in Milk and Other Biological Liquids*, the third preceding number in this series of publications, was mailed on June 26, 1923.

FOOD INDEX

(This index is arranged systematically, following the Robinson and Fernald edition of *Gray's Manual*. In looking up a caterpillar, it is best to look first for the general feeders and the forms already reported from the plant on which it was found, and then for other members of the same family, as caterpillars rarely confine themselves strictly to a single food plant.)

General feeders, normally on trees and shrubs

opercularis 102, pyxidifera 102, crispata, 102; most Eucleidæ 105–113; ephemeræformis 144, speculella 152, ainsliella 159, tentoriferella 235, algidella 252, trialbamaculella 265, scitula 372, solandriana 400, cornifoliana 406, nubeculana 408, nævana 411, argutanus 447, rhoifructana 473, caryæ 476, diluticostana 477, pettitana 477, variegana 484, ministrana 490, alleniana 492, obsoletana 494, rosaceana 496, rosana 496, rileyana 496, persicana 497, argyrospila 497, semiferana 497, limitana 498, robiniæ 519, pyrina 520, asperatella 607, regalis 665, imperialis 665, io 670, luna 671, polyphemus 672, promethea 673, cecropia 674, torrefacta 678, velleda 680, punctistriga 681, disstria 682, americana 682.

General feeders, normally on herbaceous plants

confederata 144, rutilans 370, hebesana 458, sulfureana 476, reticulatana 477, idæusalis 478, flavedana 479, osseana 488, velutinana 490, pallorana 492, alleniana 492, obsoletana 494, persicana 497, oculatana 523, fascialis 545, undalis 550, noctuella 553, bipunctalis 554, similalis 556, mancalis 557, ferrugalis 560, ainslei 568, hortuellus 603, punctidactyla 644, monodactylus 651, io 670.

General feeders on aquatic plants

ainslei 568, icciusalis 577.

Predacious or parasitic species (on aphids and scales)

aphidiel'a 311, bassettella 358, virescana ? 489, Macrothecinæ 535, coccidivora 632.

Scavengers, stored-food pests, and clothes moths

(These three types of habit intergrade so perfectly that it is not convenient to list them separately. The majority of species listed here would naturally belong to at least two of the three categories.)

Tinea spp. 124, fuscipunctella 126, pellionella 127, granella 130, tapetzella 131, Monopis spp. 131, ferruginella 132, crocicapitella 132, bisselliella 133, insectella 140, lacteella 250, cerealella 305, Blastobasidæ 308, rileyi 327, mellonella 533, sociella 534, grisella 535, julianalis 539, farinalis 585, cuprealis 586, costalis 586, ceratoniæ 614, edmandsii 631 Ephestia spp. 634–635, interpunctella 636.

Species feeding on definite foods

Microscopic water creatures

fulicalis 580.

Fungi

Scardia spp. 123, Tinea spp. 124, croceoverticella 128, multistriatella 128, rileyi 128, arcella 129, acapnopennella 129, granella 130, cristatella ? 135.

Mosses and liverworts

Micropterygidæ 63, laqueatellus 597.

Club mosses

Lycopodium: lycopodiana 476.

Lichens

Eudarcia 77, walshella 144, rileyi ? 144, Symmoca 261, adelalis 538.

Ferns (Filicales)

General: gracilis ? 69, theseusalis 561.
Osmunda: osmundana 457, æglealis ? 567.

Conifers (Pinaceæ)

General: variella ? 300, shawiana ? 428, diniana 446, dissitana ? 497, imperialis 665.
Pine (Pinus): fuliginosella 124, borkhausenii 248, vittella 288, pinifoliella 290, coniferella 300, confluentella 311, haimbachi 348, pini 368, toreuta 396, erotella 396, monitorana 427, buoliana 438, frustrana 438, rigidana 438, comstockiana 439, virginiana 439, albicapitana, 439, gemistrigulana 439, schulziana ? 452, pinatubana 490, robustella 608, zimmermanni 620, sepulcralis 665.
Larch or tamarack (Larix): laricella 209, laricella 347, columbia 674, laricis 681.
Spruce and fir (Picea and Abies): piceaella 300, youngana 393, nanana 398, tocullionana 428, picicolana 439, ratzeburgiana 446, abietana 453, variana 486, fumiferana 489, afflictana 492, packardiana 492, reniculella 620, abietella 621.
Hemlock (Tsuga): tsugensis 255, apicitripunctella 299.
Cypress (Taxodium): variella 300.
Arbor vitæ (Thuja): thujaëlla 300, freyella 346, thuiella 348.
Red cedar and juniper (Juniperus): marginella 286, juniperella 300, gibsonella 301, freyella 346, annettella 346, alternatella 347, rutilana 506.

Typhaceæ

Cat-tail (Typha): phragmitella 324, julianalis 539.

Najadaceæ

Pondweed (Potamogeton): seminealis ? 578, obscuralis 578.

Hydrocharitaceæ

Eelgrass (Vallisneria): obscuralis 578.

Grasses (Gramineæ)

General: vagans 215, graminivorella 349, maiorina 470, Crambus spp. 575–604. (Many of the species listed below will doubtless also turn out to have a variety of food-plants in the fami y.)
Beard grass (Andropogon): andropogonis 307.
Witch grass etc. (Panicum): clandestinella 333, miraculosa 359, panicifoliella 359.
Rice (Oryza): plejadellus 591.
Brachyelytrum: brachyelytrifoliella 221.
Timothy (Phleum): mistrella 253.
Meadow grass, blue grass (Poa): albicapitella 222, sylvestris 222.
Glyceria: irrorata 223.
Wild rye (Elymus): leucofrons 222, præmaturella 223.
Bottle-brush grass (Hystrix): orestella 220, prælineata 222, leucofrons 222, hystricella 283, graminivorella 349.
Corn (Zea): arcanellus 121, nubilalis 568, zeacolella 591.

Sedges (Cyperaceæ)

General: verutana 470, ekthlipsis 576.
Bulrush (Scirpus): enitescens 221, madarella 221, robusta 297, furfurana 470, maiorina 470, forbesellus 591.
Sedge (Carex): madarella 221, argentosa 221, cucullata 222.

Duckweed (Lemnaceæ)

Elophila spp. 579.

Rushes (Juncaceæ)

Juncus: unicolorella 209, quadrilineella 213, cratipennella 214, cæspititiella 214, fagicosticella 215, verutana 470, furfurana 470.
Luzula: biforis 214.

Liliaceæ

Lily (Lilium): incertella 344.
Yucca: quinquepunctella 74, yuccasella 75.
Solomon's-seal (Ploygonatum): melaleucana, 498.
Trillium: meleleucana, 498.
Cat-briar (Smilax): smilaciella 151, smilacisella 183, incertella 344, inimicella 447.

Orchidaceæ

Lady's-slipper (Cypripedium): cypripediana 473.

Salicaceæ

(Most of the species will eventually prove to occur on both willow and poplar.)
General: albe.la 151, purpuriella 175, stigmatella 175, salicifoliella 192, tricinctus. 366, albicornis 373, apiformis 374, tibialis 374, nisella 401, effractana 487.
Willow (Salix): thule 68, fuscotibiella 92, pallida 95, saliciella 152, salictella 182, salicifoliella 184, scudderella 191, sa icivorella 192, kearfottella 213, saliciella 228, inquilinella 267, niveopulvella 278, fungivorel a 296, salicifungiella 296, salicipomonella 330, bolteri 370, sigmoidea 373, gallæsaliciana 395, rectiplicana 402, diminutana 405, salicicolana 445, heindeliana 483, schalleriana 485, permutana ? 486, particípialis 550, inquilinela 623, pravella ? 624, carneella 627, fusca 628, latifascia 669.
Poplar (Populus): populella 83, populetorum 95, populiella 154, populiella 192, fletcherella 236, dyariella 268, innocuella 278, præangusta 331, dollii 366, tineana 405, duplex 456, centerensis 518, populi 519, helvalis 561, velleda 680.

Myricaceæ

Bayberry (Myrica): obscurella 89, flavella 173, picturatella 198, walsinghamella 239, indentanus 436, karacana 477, particípialis ? 531.
Sweet fern (Comptonia): electrofusca 464, comptoniella 618.

Juglandaceæ

General: juglandifoliella 90, caryæfoliel'a 197, caryana 392, juglandana 491, palliolella 617, regalis 665.
Walnut (Juglans): juglandiella 172, juglandivorella 176, nigralineella ? 216, juglandiella 228, testulana 478, demotella 616.
Hickory and pecan (Carya): trinotata 87, y-inversa 110, clemensella 159, oliväformis 191, caryæalbella 191, caryæfoliella 211, lucifluella 228, ella 228, caryæfoliella 285, aphidiella 311, bolliana 443, improbana 443, infumatana 496, fumoferalis 569, angusella 615, stigmella 616, caryivorella 616, caryæ 617, kearfottella 617, latifasciella 617, ulmiarrosorella 632, luna 671.

Betulaceæ

General: corylifo'iella 89, nisella 401.
Hazel (Corylus): quadrinotata 86, corylisella 199, corylifoliella 212, grotella 242, tortriciformella 254, tristrigella 279, trinotella 285, similana 400, walkerana 401, corylana 465, exoieta ? 468, thestialis 567, rubrifasciella 618, coryliella 618.
Ironwood, hop hornbeam (Ostrya): ostryæfoliella 89, ostryæella 175, obscuricostella 191, ostryæfoliella 191, tritænianella 194, hamadryadella 196, lentella 197, ostryarella 199, ostryæ 211, ostryæfoliella 228, ostryæella 329.
Ironwood, blue beech (Carpinus): quadrinotata 89, y-inversa 110, ostryæella 175, carpinella 211, Psilocorsis sp. 236.
Birch (Betula): ostryæfoliella 89, mora 121, coronatella 158, canadensisella 158, conspicuella 167, vicinella 168, obliterella 168, coroniella 174, martiella 193, lentella 197, betulivora 198, cinerella 210, lentella 212, betulella 242, betulel a 293, gœdartella 345, diana 353, culciformis 370, similana 400, transmissana ? 402, solicitana 402, albeolana 456, zelleriana 465, trisignana 483, niveana 484, ferrugana 487, affractana 487, betulella 618, luna 671, polyphemus 672, arcuata 690, bilineata 690.
Alder, (Alnus): argenteomaculatus 68, elongella 172, glutinella 176, auronitens 192, cinerella 210, alniel'a 212, belangerella 293, alnifructella 302, gœdartella 345, calliphanes 345, asilipennis 365, americana 370, brunneopurpurata 465, extricalis 561, rubrifasciella 618, arcuata 690.

Fagaceæ

General: packardella 158, strigifinitella 179, asperatella 607.
Beech (Fagus): faginella 236, fagella 304, fagigemmeana 468, luna 671.
Oak and chestnut: auricyanea 66, castaneæfoliella 74, saginella 95, latifasciella 94, castaneæella 198, quercicella 235, obsoletella 236.

Chestnut (Castanea): castaneæ 83, phleophaga 83, castaneæella 147, kearfottella 191, leucochrysella 216, castaneæ 239, castaneella 347, pictipes 371, fuscociliana 410, spoliana 443.
Oak (Quercus): heinrichi 83, terminella 88, altella 89, quercipulchella 90, similella 93, flavipedella 94, anguinella 97, platea 97, nasoni 109, biguttata 110, pallida 111, fuscomarginella 147, tinctoriella 148, badiiella 148, citrinipennella 148, albostraminea 148, zelleriella 148, litigiosella 157, ainsliella 159, alchimiella 176, quercinigrella 177, strigosa 179, albinotella 180, fulgidella 182, fitchella 189, bataviella 189 (footnote), quercialbella 190, argentifimbriella 190, albanotella 190, hageni 190, æriferella 190, rileyella 191, basistrigella 193, hamadryadella 196, cincinnatiella 196, macrocarpella 197, conglomeratella 197, quercivorella 197, platanoidella 197, fletcherella 198, bethunella 198, fasciella 198, obstrictella 198, tubiferella 199, atromarginata 217, querciella 217, Coptodisca sp. 228, reflexella 236, allenella 241, schlægeri 252, unipunctella 253, querciella 253, xanthobasis 253, melanella 254, bicostomaculella 267, maculimarginella 268, vernella 268, gilvomaculalla 268, ligulella 284, georgiella 285, cristifasciella 291, latifasciella 292, quercinigracella 292, fuscopunctella 292, glandulella 310, purpuriella 329, Swammerdamia sp. 339, oreasella ? 346, apicimaculella ? 346, simulans 365, palmii 366, rubristigma 371, latiferreanus 397, timidella 99, divisana 407, burgessiana 410, murtfeldtiana 410, appendicea 464, diluticostana 477, karacana 477, testulana 478, semipurpurana 481, quercifoliana 491, fervidana 496, grisea 498, macmurtrei 519, hebescella 617, hammondi 632, ostrinella 636, chiridota 657, melsheimeri 658, stigma 667, virginiensis 668, senatoria 668, maia 669, cymatophoroides 687.

Urticaceæ

General: fabriciana 352.
Elm (Ulmus): apicialbella 90, ulmella 92, Marmara sp. 182, argentinotella 192, occitanica 192, ulmella 197, limosipennella 212, costrictella 307, undulatella 347, fuscociliana 410, asperatella 607, ulmiarrosorella 632.
Hackberry (Celtis): ovina 102, celtisella 193, celtifoliella 194, rubrisparsella 623, celtidella 626.
Osage orange (Maclura): externalis 555.
Nettle (Urtica): urticata 581.
Richweed (Pilea): pulchrimella 332.

Santalaceæ

Bastard toadflax (Comandra): comandrana 484.

Polygonaceæ

Sorrel, dock (Rumex): discoocellella 266, fasciatana 463.
Smartweed, knotweed (Polygonum): borea 214, shaleriella 214, discoocellella 266, absconditella 296, minimella 296, ainslei 568.

Chenopodiaceæ

Pigweed (Chenopodium): lingulacella 298, hermannella 298, ranalis 546.
Beet and chard (Beta): perspectalis 544, fascialis 545, bipunctalis 554, sticticalis 556.

Amaranthaceæ

Pigweed, Amaranth (Amaranthus): amaranthella 215.
Alternanthera: perspectalis 544, fascialis 545.

Phytolaccaceæ

Poke (Phytolacca): obscuralis 548, æglealis 567.

Nyctaginaceæ

Oxybaphus: nyctaginella 358.

Caryophyllaceæ

Chickweed (Stellaria): cœnosipennella 214.
Campion (Silene): apicialbella 210.

Water lilies (Nymphæaceæ)

penitalis 568, obliteralis 577, gyralis 577, maculalis 577.

Ranunculaceæ

Meadow rue (Thalictrum): fuscipedella ? 245.
Clematis: caudata 374, maculata ? 522.
Marsh marigold (Caltha): Opostega ? 160.

Magnoliaceæ

General: liriodendrana 473, angulifera 673.
Tulip tree (Liriodendron): liriodendrella 154, ostricolorella 631, promethea 673.
Magnolia: magnoliella 154, hamadryadelia 196, magnoliana 498, carolina 673.

Anonaceæ

Papaw (Asimina): plummeriana 388, cariosa 588.

Berberidaceæ

Barberry (Berberis): dentosa 588.

Lauraceæ

Red bay (Persea): parvula 340.
Sassafras: sassafrasella 172, niveiguttana, 459, saracana 476, fissalis 567.

Mustard family (Cruciferæ)

General: maculipennis 341, porrectella 341, undalis 550, straminalis 551, rimosalis 551.

Sarraceniaceæ

Pitcher plant (Sarracenia): dæckeana 458.

Saxifragaceæ

Saxifrage (Saxifraga): saxifragæ 371.
Alum root (Heuchera) heucherana 403.
Hydrangea: hydrangiæella 226, ferruginana ? 468, ferriferana 469.
Currant, gooseberry (Ribes): taylorella ? 75, albogalleriella 161, tipuliformis 372, exoleta ? 468, fernaldana 515, grossulariæ 630.

Hamamelidaceæ

Witch-hazel (Hamamelis): superbifrontella 176, hamameliella 199, argutanus 447, niveiguttana 459, merrickana 466, footiana 470.
Sweet gum (Liquidambar): liquidambarisella 154, dorsivittella 301, afflictella 625, regalis 665.

Platanaceæ

Sycamore (Platanus): platanella 92, clemensella 93, albisparsella 267, divisana 407, platanana 409, ovulalis ? 547, militella 607.

Rosaceæ

(In this family especially, the species tend to feed on members of several related genera. The Ericaceæ seem to be closely related to this family biologically, and there is a tendency for the forms feeding on either to stray to the other.)

General: cratægella 191, fletcherella 209, Tinagma 224, splendoriferella 227, padella 339, falciferella ? 341, exitiosa 370, pictipes 371, pyri 372, prunivora 392, pomonella 396, tineana 405, permundana 466, permutana 486, indiginella 619, americana 681, scripta 686, rectangula 687.
Ninebark (Physocarpus or Opulaster): opulifoliella 90.
Meadow sweet, Steeple-bush, Hardhack (Spiraea): spiræifoliana 410, hemidesma 458, albiciliana 458, aruncana 472, spiræifoliana 472, lucina 670.
Apple, pear, chokeberry, mountain ash, (Pyrus): pomivorella 93, chalybeia 93, malifoliella 147, pomifoliella 158, guttea 166, geminatella 167, quadripunctella 168, sorbi-

vorella 168, arbutifoliella 168, fraxinella 177, elotella 182, pomonella 183, malimali foliella, 191, cerasivorella 208, malivorella 217, ligulella 284, quaintancella 310, mali gemmella 312, conjugella 347, pariana 353, pomonella 396, septemberana ? 399, nubecu lana 408, ocellana 435, improbana ? 443, chionosema 456, ma ana 467, minuta 482 phœnicialis 570, hammondi 632, velleda 680, americana 681.
Quince (Cydonia): geminatella 167, malimalifoliella 191.
Shadbush (Amelanchier): amelanchierella 97, Psilocorsis sp. 236.
Thorn (Crataegus): scintillians 86, cratægifoliella 94, anglicella 167, cratægifoliella 167 melanotella 167, inusitatumella 168, cratægella 301, curvi ineella 329, dietziana 411 chionosema 456, niveiguttana 484.
Strawberry (Fragaria): anglicella 167, comptana 408 (floridana 407?), fragariana 488
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THE MORPHOLOGY OF THE DOUBLE KERNEL IN ZEA MAYS VAR. POLYSPERMA

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THE MORPHOLOGY OF THE DOUBLE KERNEL IN ZEA MAYS VAR. POLYSPERMA

MILDRED E. STRATTON

Blaringhem (1920) recently reported the production of a new variety of corn, to which he gave the name *Zea mays* var. *polysperma*. The varietal name is descriptive of the outstanding characteristic of the strain, namely, the occurrence of a large number of double and a few triple kernels on the ear. By way of explanation it may be pointed out that double and triple kernels are those with two and three embryos, respectively.

In view of the fact that this characteristic is apparently hereditary, a morphological study of the development of the double kernel in this strain, with special emphasis on the origin of this doubleness, seemed of sufficient importance to the geneticist and the morphologist to warrant the preparation of this paper.

HISTORY

The morphology of the normal pistillate spikelet, with its one functional and one aborted flower, has been worked upon by a number of investigators (True, 1893; Guignard, 1901; Poindexter, 1903; Kempton, 1913; Weatherwax, 1916 and 1917; Miller, 1919). From such a spikelet there ultimately develops a single grain with one embryo. The papers of Weatherwax give a comprehensive and thorough summary of the development to the time of fertilization. The period between fertilization and the maturing of the caryopsis has been studied by True (1893) and by Poindexter (1903).

The development of more than one grain in a spikelet has been reported for several varieties of corn. As early as 1894, Sturtevant (1894) reported that in pod corn he had occasionally found two grains in a pod (kernels twinned in the pod). Kempton (1913) observed that in three varieties of corn — one grown by the Hopi Indians of Arizona, a hybrid form made up of varieties from China, Salvador, and Mexico, and *Zea tunicata* — some of the kernels were apparently inverted, that is, the embryo was borne on the side of the kernel toward the base of the cob, instead of on the side toward the apex, as normally. This inversion of kernels Kempton attributed at first to the crowding of kernels on the ear, but after dissecting an ear with inverted kernels he offered the true explanation, namely, that both flowers of the spikelet had developed into seeds, the seed from the lower flower becoming inverted. The crowded condition in the Country Gentleman variety also is due to the development of both flowers of the pistillate spikelet to form two separate seeds, arranged back to back (Stewart, 1915; Weatherwax, 1916).

Furthermore, in many cases in the Hopi and the China-Mexico-Salvador varieties, in which the normally aborted flower develops, two seeds on the spikelet thus resulting, these seeds become united back to back and are

inclosed in a common pericarp. These double kernels, which Kempton (1913) terms "connate seeds," are to be regarded as true two-seeded fruits.

It has never been recorded that two corn seeds from different spikelets unite to form a connate seed, nor has the formation of connate seeds in pod corn been observed. Kempton states that the lack of coalescence of the two grains in the latter case may be due to the large size and rapid development of the surrounding bracts.

It has therefore been shown that both flowers in the maize spikelet may sometimes develop, giving twinned seeds (Country Gentleman) or connate seeds (Hopi variety). It now remains to be shown what the origin of the double condition is in Blaringhem's *Zea mays* var. *polysperma*.

MATERIAL AND TECHNIQUE

The material used in this study was collected from plants which were grown from seed of *Zea mays* var. *polysperma* obtained from Blaringhem. Previous to the time of fertilization, ears varying from 2 to 30 millimeters in length were fixed in chromo-acetic and chromo-acetic-osmic solutions, including that of Flemming, after which they were embedded in paraffin and sectioned 5 to 10 μ thick. Delafield's Haematoxylin was used for staining. The study of later stages was supplemented by material which had been allowed to mature.

DESCRIPTION

Normal pistillate spikelet

A brief description of the normal structure and development of the pistillate spikelet as it occurs in most varieties of *Zea mays*, is essential as a basis for comparison with the abnormal conditions to be described later.

The spikelets of the pistillate inflorescence are borne in pairs on short pedicels of about equal length, and are arranged in double longitudinal rows, the adjoining pairs alternating with one another.

Normally, each spikelet bears two flowers, one functional and the other aborted (figure 1). Although all parts of the typical grass spikelet are present, the stamens remain as inconspicuous rudimentary organs, irregularly spaced at the base of the ovary.

The glumes at the base of the spikelet are rather large and fleshy, but they never completely surround the spikelet except in pod corn. The lemma, subtending each flower with its palea, is smaller and thinner.

Weatherwax (1917) claims that lodicules also are present during the early stages in both flowers of the female spikelet. However, the development of these organs is soon arrested, and they become wholly or partially obliterated by the growth of the surrounding tissue. Weatherwax says: "At anthesis those [lodicules] of the upper flower are seldom visible, while those of the lower flower are relatively conspicuous, even when such flower has a functional pistil." In his earlier paper (1916) Weatherwax figures a lodicule in the lower flower of the Country Gentleman variety (figure 7, a), but in his later paper (1917) his drawings do not show the lodicule at any stage of the development of the spikelet. Neither do Kempton's investigations reveal the presence of lodicules.

The writer has so far been unable to discover in *Zea mays* var. *polysperma* any structures which could be regarded with certainty as lodicules or lodicule primordia. However, since the presence or the absence of these

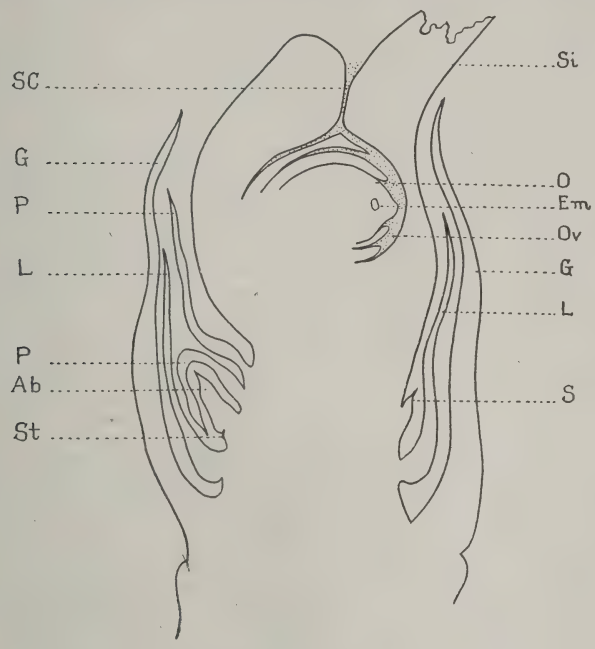

FIGURE 1. LONGITUDINAL SECTION OF A NORMAL PISTILLATE SPIKELET OF ZEA MAYS VAR. POLYSPERMA. × 70

G, Glume; L, lemma; P, palea; S, stamen of functional flower; St, stamen of aborted flower; Ab, pistil of aborted flower; SC, stylar canal; Si, silk; O, ovule with its two integuments; Ov, ovarian cavity; Em, embryo

structures is of relatively minor importance in connection with the present problem, this point was left unsettled.

Morphological development

The development of the normal pistillate spikelet has been carefully studied and well figured by Weatherwax (1917). The writer finds practically the same sequence in the origin of parts in the normal spikelet of *Zea mays* var. *polysperma*, as is shown by the following description.

By the time the young ear is approximately 2 millimeters long, the spikelet primordium appears in a depression as a very small, deeply stained, rounded protuberance (figure 2, a). Growth proceeds rapidly at this stage, and the primordium soon becomes larger and more prominent. This difference is apparent even in a single ear, since the primordia at the base are much larger than those near the apex.

By the time the spikelet primordium has grown sufficiently to extend well beyond the general surface of the cob, the differentiation of parts takes place. The glume of the lower flower appears first (figure 2, b) and

is soon followed by that of the upper flower. At this time the termina portion, from which the two flowers are to develop, appears as a smal rounded projection (figure 2, c). The two lemmas next appear. The ter

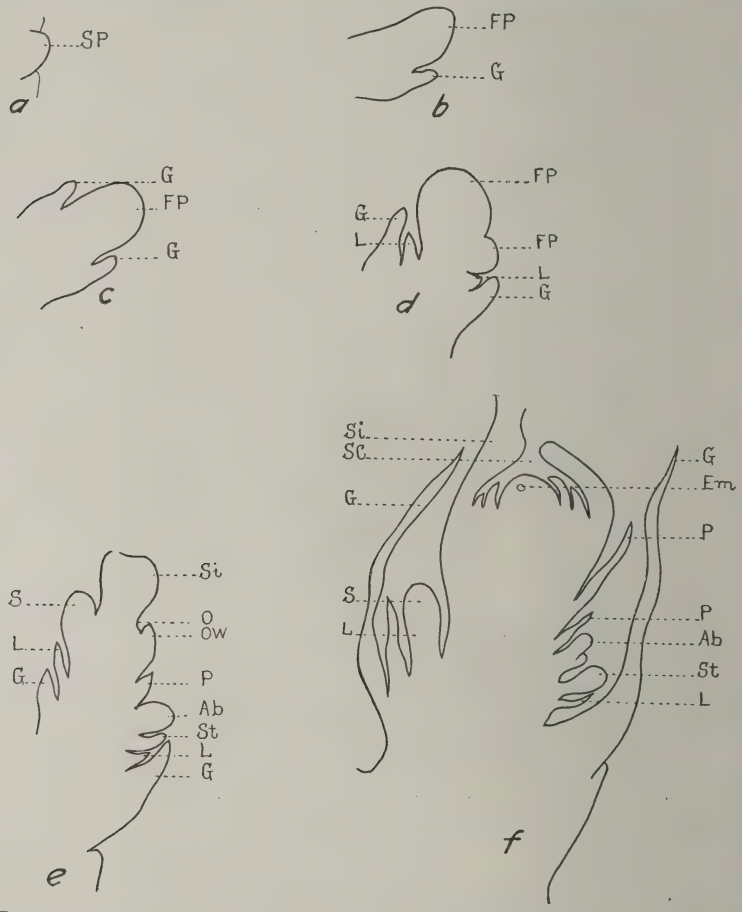

FIGURE 2. STAGES IN THE DEVELOPMENT OF THE NORMAL PISTILLATE SPIKELET OF ZEA MAYS VAR. POLYSPERMA. × 70

FP, Flower primordium; SP, spikelet primordium; OW, ovary wall. Other abbreviations as in figure 1

minal portion soon shows a small lateral protuberance near its base. This represents the primordium of the aborted flower, the main portion being the primordium of the functional flower (figure 2, d).

The first steps in the differentiation of the ovary are soon visible at the apex of the primordium of the upper flower. The carpellary tissue, which in a longitudinal section appears as two protuberances of unequal size, develops upward to form the ovary wall. This soon closes over the ovule, which first appears as a small protuberance (figure 2, e), and the tissue on the side away from the spikelet axis continues upward to form the elongated

silk. At the base of the silk the stylar canal remains as a funnel-shaped opening extending from the exterior into the ovarian cavity.

During the growth of the ovary wall and the silk, the integuments of the ovule begin to develop. The inner integument, which grows more rapidly than the outer one, closely surrounds the ovule, while the outer inclines toward the opening of the stylar canal (figure 2, f).

The stamens appear very shortly after the ovary begins its differentiation (figure 2, e), but by the time the ovule is well formed they have ceased to grow, and remain functionless. The paleas of the two flowers of the spikelet also appear very early (figure 2, e), first as a single mass of tissue between the flowers, this tissue later differentiating into two organs.

By the time the embryo sac has reached maturity the ovule has become inverted (modified campylotropous or semi-anatropous), due to the rapid growth of tissue on the adaxial side. The inner integument surrounds the nucellus, whereas the outer one does so only partially, a part of it becoming folded back as a stopper in the stylar canal. The rudimentary stamens now appear as deeply stained masses of disintegrated tissue (figure 1).

The lower flower ceases differentiation at an early stage, and remains in an aborted state at the base of the functional flower (figure 1).

Abnormal pistillate spikelet

Though normally the pistillate spikelet has one functional and one aborted flower, both flowers in the spikelet may develop and function, resulting in any one of the following conditions:

a. A pair of separate kernels.
b. Connate seeds (Kempton)—a two-seeded fruit formed by the coalescence of parts of the two flowers.
c. Semi-connate seeds — a series of kernels intermediate between *a* and *b*.
d. Single seeds with double embryos.
e. Triplets.

A pair of separate kernels

As already stated, both flowers of the spikelet are occasionally functional, as, for example, in the Hopi and China-Mexico-Salvador varieties (Kempton, 1913) and in the Country Gentleman variety of sweet corn (figure 7, a) (Stewart, 1915; Weatherwax, 1916). The resulting kernels therefore occur in pairs, the upper kernel having its embryo on the adaxial (upper) side, and the lower kernel having it on the abaxial (lower) side. The two seeds are therefore said to be *back to back*, the lower one being *inverted*.

According to Kempton (1913), the kernels formed by the two flowers of the spikelet usually are of the same size, germinate equally well, and produce seedlings of apparently the same vigor. In a few cases the kernels from the lower flowers are smaller than those from the upper ones. Weatherwax (1916) says: "In appearance and structure this functional lower flower of Country Gentleman sweet corn is similar to the upper one, but it is often somewhat smaller." (Figure 7, a.)

The writer found in *Zea mays* var. *polysperma* a few completely separate kernels, arranged back to back just as in the Country Gentleman variety; the embryos in these were arranged adaxially and abaxially with respect to the cob (figures 3, a, and 4, a). The difference in size of kernels noted by

other investigators was not apparent in *polysperma*. Moreover, the kernels in *polysperma* maintained their normal rounded shape and arrangement (regular, double, longitudinal rows). The kernels in the other varieties, Hopi and Country Gentleman, are long and narrow (shoe-peg type), due possibly to crowding on the ear.

Weatherwax (1916) finds that the kernels of Country Gentleman develop from primordia which have a very regular arrangement, whereas Kempton reports an irregular arrangement of the primordia in Hopi. Kempton

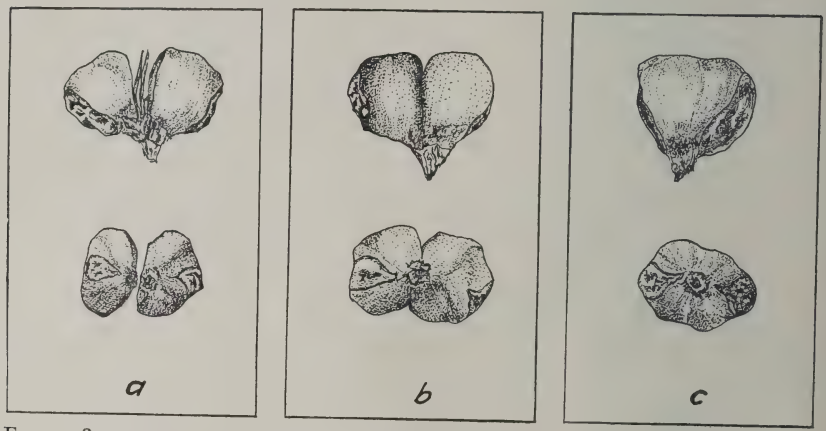

FIGURE 3. EXTERNAL VIEWS OF KERNELS DEVELOPED FROM A SINGLE SPIKELET. THE GERMS APPEAR AT THE RIGHT AND AT THE LEFT

a, Separate seeds; b, semi-connate fruit; c, connate fruit

states further that in Hopi and in the China-Mexico-Salvador hybrid the spikelets with two functional flowers are aggregated mainly at the apex of the cob, this region thus showing more primitive characteristics. In a number of Country Gentleman ears observed by the writer, on the contrary, the spikelets in the upper fifth of the cob had formed one kernel each, giving regular longitudinal rows, while in the remainder of the cob they had formed two kernels. Furthermore, the kernels in the latter region, though irregularly arranged and smaller than those at the apex, were well rounded and not of the shoe-peg type.

Connate seeds (double kernels)

Kempton (1913) records the occurrence of connate seeds in the Hopi and China-Mexico-Salvador varieties of *Zea mays*, and defines them thus: "Both seeds from the same spikelet develop, they are united back to back, making what resembles one seed with two germs on opposite sides." (Figures 3, c, and 4, b, c, and e.) Here both seeds are actually inclosed by a common pericarp, forming what is really a two-seeded fruit or kernel. In his work on the kernels of the Hopi variety Kempton made the following observations:

1. Connate seeds are twice as large as the normal grain.
2. The two halves germinate at about the same time and produce seedlings of equal vigor.

3. These connate seeds are fertilized through a double silk which is attached to the pericarp near the union of the two seeds.

4. The two embryos in the double kernel are arranged above and below with respect to the cob as an axis.

Connate seeds (double kernels) are numerous in *Zea mays* var. *polysperma*. In a careful macroscopic and microscopic examination of

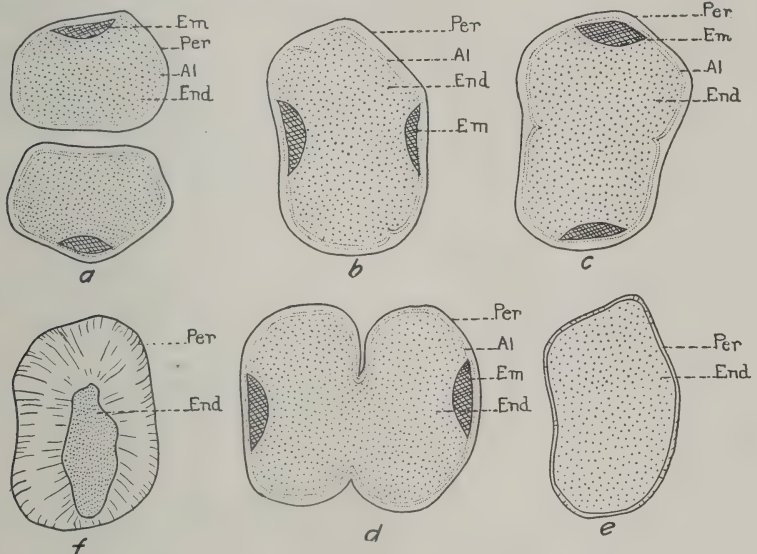

FIGURE 4. STRUCTURE OF VARIOUS TYPES OF KERNELS DEVELOPING FROM A SINGLE SPIKELET

Al, Aleurone layer; Em, embryo; End, endosperm; Per, pericarp

a, Transverse section of separate caryopses developed from a single spikelet of *Zea mays* var. *polysperma*

b, Transverse section of a connate seed of the Hopi variety of sweet corn. (After Kempton, modified)

c, Transverse section of a connate seed of *Zea mays* var. *polysperma*

d, Transverse section of a semi-connate seed of *Zea mays* var. *polysperma*

e, Surface view of a connate seed split along the line of union of the two component seeds

f, Surface view of a semi-connate seed split along the line of union of the two component seeds

their kernels, the writer found several conditions differing in the following ways from those described by Kempton:

1. While the connate seeds vary more or less in size (from normal to slightly less than twice normal), the majority have approximately the size of normal kernels.

2. Seventy-five connate seeds were planted and the developing seedlings observed. If the double kernels are planted without separating the two seeds, both seeds germinate, and the seedlings, which grow up very close together with about the same vigor, are considerably smaller and grow more slowly than those developing from normal kernels from the same ear.

On the other hand, if the two seeds of the double kernel are separated, as can be done easily, and are then planted some distance apart, the resulting seedlings develop just as rapidly, are just as strong, and fruit just as early and profusely, as the plants from normal seeds. Thus the difference in seedlings is apparently due to physical crowding, rather than to any fundamental difference in the viability of the seeds.

3. The writer has never found a connate seed from *Zea mays* var. *polysperma* with a double silk. Frequently the two silks are so close together that a hand lens is necessary to detect the presence of both silks on the mature kernel. However, with this help both are plainly visible. Furthermore, a microscopic study of the developmental stages of these double kernels bears out the conclusion that the two silks are distinct (figure 8, b).

4. Another condition in *Zea mays* var. *polysperma* at variance with those found in the Hopi and China-Mexico-Salvador varieties has to do with the position of embryos in the kernel. Kempton figures a kernel of the connate type from the Hopi variety of *Zea mays*, in which the two embryos lie opposite each other on the two flat sides of the kernel, thus facing the apex and the base, respectively, of the cob. The line of union between the two seeds is oblique, but is nearly parallel to the flat sides of the kernel (figure 4, b).

In variety *polysperma* the embryos are arranged opposite each other, but at the right and left edges of the kernel instead of above and below as in Hopi. The line of union is here transverse, and not oblique, and is perpendicular to the slightly flattened faces of the kernel (figure 4, c).

A plausible explanation of this difference in the position of the embryos is not forthcoming as yet, though a more extensive study might suggest one.

Semi-connate seeds

Zea mays var. *polysperma* offers a clue to the origin of connate seeds which has not been mentioned by other writers. Between the condition in which two entirely separate kernels develop from a single spikelet, and that in which a two-seeded fruit develops from the two flowers of a single spikelet, are a number of intermediate conditions in which the kernels show various degrees of coalescence (figures 3, b, and 4, d and f).

Some of these kernels are so nearly separate that a careful examination is necessary to discover that the the endosperms of the two seeds have a small point of contact. The microscope shows that the flowers from which these kernels later develop are slightly fused. The flowers are bent a little toward each other, their stalks as well as the basal parts of the paleas being coalesced (figure 8, a). Thus we have, ultimately, kernels slightly fused at the center but each almost entirely surrounded by its own pericarp.

In kernels showing greater coalescence, less pericarp separates the seeds and greater areas of the latter are in contact. In fact, in many cases a longitudinal section near the bottom of the kernel might very well pass for a longitudinal section of a true connate seed, whereas a section at a higher level shows that the coalescence does not involve that region.

Single seeds with double embryos

W. L. Goss, who has charge of the germination work of the Seed Laboratory of the United States Department of Agriculture, has reported two single seeds with double embryos (Kempton, 1913). In these cases the kernels were of normal size and shape but had exceptionally large

embryos. The writer finds no instance of this condition existing in *Zea mays* var. *polysperma*.

Triplets

According to Kempton (1913), the Hopi and China-Mexico-Salvador varieties illustrate a further abnormal condition with respect to the number

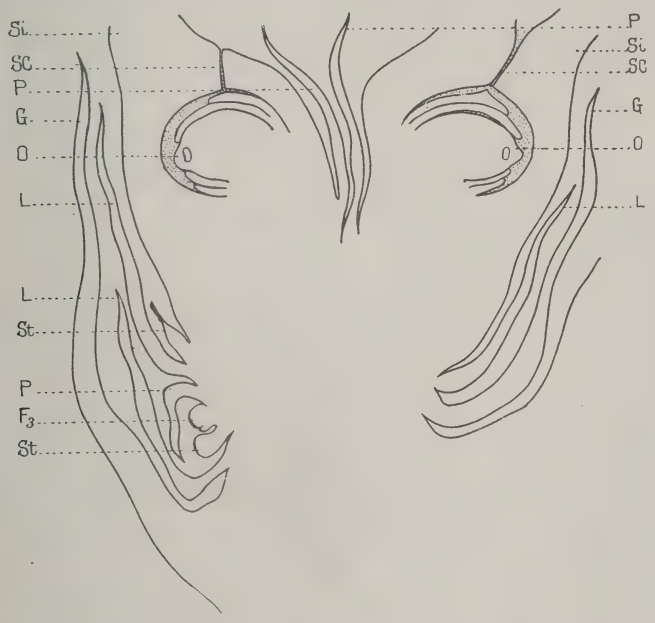

FIGURE 5. LONGITUDINAL SECTION OF AN ABNORMAL PISTILLATE SPIKELET OF ZEA MAYS VAR. POLYSPERMA

F_3, Third flower, aborted. Other abbreviations as in figure 1

of functional flowers per spikelet. This was the occasional development of three kernels from one spikelet.

The nearest approach to this condition found during the present work on *Zea mays* var. *polysperma* is the presence in a spikelet of two functional and one aborted flower (figure 5). While no triplets have been noted, the occurrence of three flowers in a spikelet, even though one is aborted, gives a clue to the triplet grains found in other varieties.

Morphological development of the abnormal pistillate spikelet

The several abnormal types of maize fruits described in the foregoing pages (twin kernels, connate seeds, and semi-connate seeds) have been assumed to be the results of the functioning of both flowers of the spikelet. That this is the true explanation is evident from an examination of the developmental stages in each type.

The initial stage in the development of the spikelet is the same, whatever the type of fruit to which it will give rise; the spikelet primordium appears

as a single small, rounded, deeply stained protuberance (figure 6, a). Notwithstanding this apparent likeness, a difference is soon noticeable. With the first differentiation of parts in the spikelet — that is, with the appearance of the lower glume — the primordium becomes bilobed, the lobes, which are the two flower primordia, being about equal in size (figure 6, b).

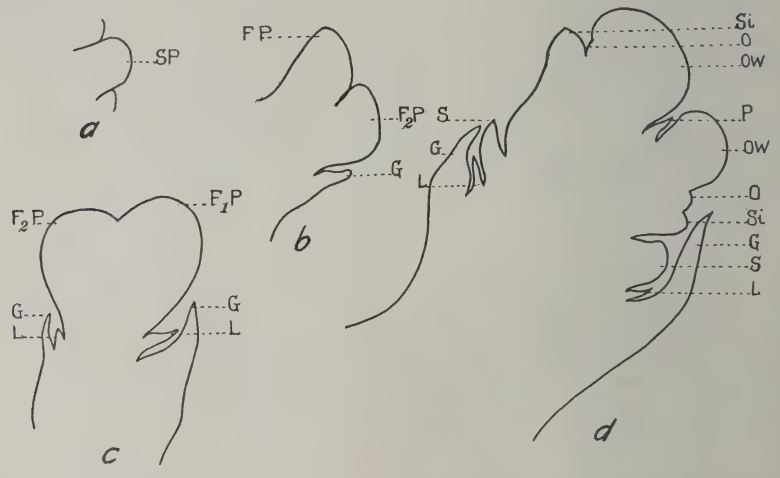

FIGURE 6. STAGES IN THE DEVELOPMENT OF THE ABNORMAL PISTILLATE SPIKELET OF ZEA MAYS VAR. POLYSPERMA

F_1, Upper flower, normally functional; F_2, lower flower, normally aborted but here functional. Other abbreviations as in figures 1 and 2

From this point the two flowers develop with equal rapidity and reach maturity, in contrast to the normal condition, in which one flower soon aborts. The developmental stages in each flower are essentially similar to those described for the normal functional flower, all differences observed being due to the various degrees of coalescence of the two flowers, which finally result in a series of abnormal types of fruits.

In figures 6, 7, and 8 are shown stages in the development of the spikelet in which both flowers are functional. Up to the stage shown in figure 6, d, the development is the same for all the types of abnormal fruits. This figure shows the two flower primordia about equally developed, and in each one the ovary, with its single ovule, is beginning to differentiate. Below each flower are the primordia of the glume, the lemma, and the stamens. The only essential difference between this and the normal spikelet (figure 1) is in the relatively large size and the degree of differentiation of the lower flower.

From this point on to maturity, the development varies in different spikelets as regards the degree of coalescence of the two flowers. As already pointed out, there results a series of conditions: a pair of separate kernels arranged back to back; a number of intermediate types designated as semiconnate seeds; and connate seeds. Each spikelet, no matter into which type of fruit it is finally to develop, has the same arrangement of glumes,

lemmas, and probably stamens. Three representative spikelets are shown in figures 7, b, and 8, a and b.

In figure 7, b, is shown a longitudinal section of a spikelet in which the two flowers are equally developed and subtended by their paleas, which are

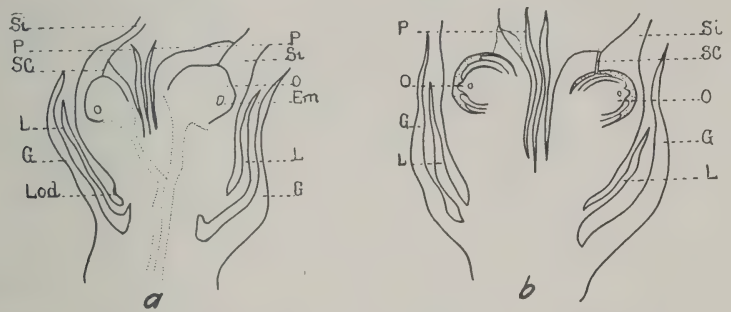

FIGURE 7. LONGITUDINAL SECTION OF PISTILLATE SPIKELET

a, Spikelet of Country Gentleman sweet corn, × 12 (after Weatherwax). Lod, Lodicule; other abbreviations as in figure 1
b, Spikelet of *Zea mays* var. *polysperma*, × 15. Both flowers of the spikelet have developed and will result in separate kernels

separate throughout their length. This pair of flowers would give rise to two distinct but closely placed kernels arranged back to back.

In figure 8, a, the two flowers show a marked degree of coalescence, the two pistils being continuous at the base and separated above, a small mass

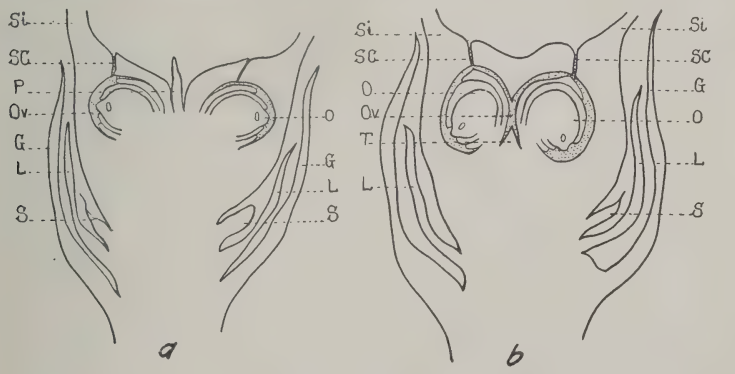

FIGURE 8. LONGITUDINAL SECTION OF PISTILLATE SPIKELET OF ZEA MAYS VAR. POLYSPERMA, WITH BOTH FLOWERS DEVELOPED

a, Semi-connate seed developing
b, Connate fruit developing. T, Remnant of axis and palea tissues; other abbreviations as in figure 1

of tissue representing the fused paleas projecting between them. In many spikelets the fusion of the paleas does not extend to the tips, while in others no palea tissue is discernible. From such a structure a semi-connate kernel would develop.

The most advanced stage in coalescence of parts of the spikelet is represented by figure 8, b, which shows a longitudinal section of a spikelet that will develop into a connate seed. The ovules are now lying back to back with their integuments in contact; the paleas are lacking entirely. Near the stalks of the ovules (toward the axis of the spikelet), separating the basal part of the integuments of the two ovules, is a small, wedge-shaped piece of tissue, which is all that remains of the axis and palea tissues that in other forms grow up between the integuments throughout their extent. The tissue of the ovary wall has grown over the ovules, thus enclosing them in a common wall which later becomes the pericarp. The two silks are completely separate; the two stylar canals are still evident as two openings from the exterior, but they are located considerably closer together than in the semi-connate type. It is to be noted that the common ovary wall completely surrounds the two ovules, which lie in contact but never have their integuments fused as far as has been observed. Thus it is evident that this connate fruit should never be mistaken for a single seed with two embryos.

These three examples — separate kernels arranged back to back, semi-connate seeds, and connate seeds — which might be supplemented by a number of intermediate conditions, show conclusively that the two pistils of the spikelet, each with a single ovule, may in some cases become coalesced to form a common ovary enclosing the two ovules, this whole structure developing into a kernel with two seeds.

DISCUSSION

The foregoing description affords a basis for the discussion of three important points:

1. The phylogenetic significance of the functioning of more than one flower of the maize spikelet.
2. The relation of the double kernel to true polyembryony.
3. A comparison of the genetic constitution of the two embryos, so far as characters contributed by the female parent are concerned.

Considered from an evolutionary point of view, the functioning of both flowers of a pistillate spikelet presents an interesting problem. What is the significance of two separate kernels arising from the flowers of a single spikelet? Of what significance, if any, is the double kernel in this connection?

Students of the morphology and taxonomy of grasses have concluded that the many-flowered spikelet represents a primitive condition, and the few-flowered spikelet a derived, or specialized, condition. The normal maize spikelet, in which there is only one fertile pistil, is accordingly regarded as a very highly specialized form, although there is, to be sure, the vestige of a second flower present.

As already shown in the foregoing description, there are, in certain varieties of corn, spikelets on which the two flowers develop to maturity, that is, form kernels. Thus there is in these abnormal spikelets a reversion to the more primitive condition, though the spikelet is scarcely what can be called *many-flowered*. A still greater reversion toward the condition existing in the primitive grass spikelet is shown by those occasional spikelets in *Zea mays* var. *polysperma* having three flowers, two of which are functional.

Connate seeds represent a very interesting variation in the ultimate development of a spikelet with two functional flowers. The coalescence of two flowers which results in the production of double fruits can be looked upon only as a derived condition. Double kernels (connate seeds) of maize, therefore, involve a primitive feature in that they result from the development of two flowers in spikelets of a species ordinarily having only one functional flower, and at the same time show a derived condition in the fusion of the two resulting fruits. Semi-connate seeds, intermediate between separate kernels and connate seeds, illustrate stages in the evolution of this derived condition.

Another outstanding question arising from this study of double kernels (connate seeds) is the relation of these double kernels to seeds having two embryos.

Coulter and Chamberlain (1903) give a comprehensive treatment of true and false polyembryony as it occurs in angiosperms, and present a classification, based on that of Ernst (1901), of known cases of true polyembryony. The examples of true polyembryony are listed under two general heads, depending on the origin of the second embryo: (1) from cells outside the sac, hence from sporophytic tissue (for example, embryos from cells of the nucellus, as in *Citrus aurantium*, and from cells of the integument, as in *Allium odorum*); (2) from cells within the sac (for example, the normal occurrence of two eggs, as in *Santalum album*; from synergids, as in *Lilium martagon*; splitting of embryo derived from egg, as in *Loranthus europaeus*; embryos from antipodals, as in Allium and Lilium).

In all the cases of polyembryony just cited, the second embryo is derived from the tissue of the *same* flower as the normal embryo, whereas the second embryo in the double kernel of *Zea mays* var. *polysperma* is the result of the fertilization of a *second* flower. As has already been stated, these seeds in *Zea mays* become coalesced and inclosed in a common pericarp, giving the outward appearance of a polyembryonic seed.

Thus, although polyembryony is a more or less common phenomenon in angiosperms, it represents a phenomenon distinct from the more unusual condition described for *Zea mays* var. *polysperma*.

Although the formation of connate seeds is unusual in *Zea mays*, it is not to be regarded as unique in this species. The fruit of *Mitchella repens* (the partridge berry) is normally formed by the coalescence of two flowers, producing a two-seeded fruit inclosed in a common pericarp. Morphologically, then, the connate maize kernel and the common partridge berry are similar.

The difference that has been pointed out between true polyembryony and the condition present in *Zea mays* var. *polysperma* is of importance to the geneticist who desires to know how the two embryos may be compared as regards the maternal-inheritance factors which they carry.

Evidence brought forward by geneticists and cytologists indicates that segregation of hereditary factors occurs at the reduction division, and therefore two spores of a megaspore tetrad differ from the other two in genetic constitution. Furthermore, in maize, as in most angiosperms, the embryo sac is derived from one megaspore (Weatherwax, 1919). From these facts the following inferences may be drawn:

(1) Any two embryos derived from two cells of the same female gametophyte would carry the same maternal characters, barring the

effect of possible factor mutations. (In a sac of the Lilium type, in which all four reduction nuclei cooperate to form the female gametophyte, two embryos from an egg and a synergid would presumably be similar in this respect, whereas two embryos from an egg and an antipodal cell would differ.)

(2) Two embryos arising in different embryo sacs in the same nucellus, provided the two sacs are not from two sister megaspores, would carry different sets of maternal characters, except in possible rare cases of identity due to chance. The two embryos in such cases might differ as greatly in their maternal factors as any other two arising from the same plant.

(3) An apogamous embryo arising from a nucellar cell which has budded into the embryo sac would carry the full outfit of maternal factors unaltered, and these only. Furthermore, it would differ from an embryo arising from a fertilized egg or any other gametophyte cell, since the latter embryo would carry a reduced number of maternal factors, plus paternal ones.

(4) Two embryos arising from embryo sacs in different flowers, although these flowers may be more or less coalesced, would obviously differ, except in rare chance cases of similar factor assortment, as in (2) above.

Zea mays var. *polysperma* falls under (4), so that the two plants developing from the connate seed would differ as greatly in their maternal characters as would plants arising from any other two seeds of the same mother plant, barring the effects of somatic mutation which would presumably more often cause dissimilarity in seeds originating far apart than in those arising very near each other.

The condition in *Zea mays* var. *polysperma* is therefore not to be confused with true polyembryony, as in (1), in which identity in maternal-factor complements might be expected. The two plants arising from the double kernels of *Zea mays* var. *polysperma* may thus be treated by the geneticist in the same manner as any other two plants arising from adjacent kernels.

SUMMARY

1. The spikelets of the pistillate inflorescence are borne in pairs and arranged in double longitudinal rows.

2. Normally, each spikelet bears two flowers, one functional, the other aborted.

3. Numerous spikelets in *Zea mays* var. *polysperma* have two functional flowers.

4. The functioning of both flowers of the spikelet results in:
   a. A pair of separate kernels arranged back to back.
   b. Connate seeds (double kernels), which are kernels with two seeds arranged back to back and inclosed in a common pericarp formed from the coalesced ovaries of the two flowers.
   c. Semi-connate seeds — caryopses with the two seeds less coalesced than in the connate type, the pericarp extending more or less between them.

5. Except for minor differences due to their frequent coalescence, the two flowers develop in a manner exactly comparable to that of the functional flower of the normal spikelet.

6. The development of two flowers in a spikelet, instead of one, is recognized as a reversion toward a more primitive many-flowered condition.

7. The coalescence of parts of two flowers illustrates a derived condition.
8. Connate seeds exemplify pseudo-polyembryony, never true polyembryony, in that two flowers are always involved in the production of these kernels.
9. In so far as maternal characters are concerned, the genetic constitutions of the two embryos in a connate seed may be expected to differ as greatly as those of the embryos of any other two seeds from the same parent plant.

ACKNOWLEDGMENTS

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THE INHERITANCE OF BLOTCH LEAF IN MAIZE

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GRADES OF BLOTCH LEAF

In most of the writer's work with blotch leaf, the amount of blotch has been estimated roughly and recorded in grades from 1 to 7. In making these estimates, both the relative size and the number of blotches have been considered. In grade 1 are placed the plants that have very few blotches and those with only a single blotch. At the other extreme, grade 7, are the plants all leaves of which have numerous and usually large blotches. (Plate II.) Such plants often have so large a part of their leaves dead that they are noticeably enfeebled. Plants on which no blotch is found are classed as grade 0. While there is no doubt that grading the same lot of plants in this rough way on different days might result in somewhat different distributions to the several grades, it is believed, nevertheless, that no large errors have been introduced thru the use of this method. This will perhaps be made sufficiently clear by the comparisons shown in tables 1 and 2. A pedigree culture made up of bóth blotched and normal plants was grown in 1918, and a duplicate of it in 1919. The grades of blotch assigned to the plants of these duplicate cultures are shown in table 1:

TABLE 1. COMPARISON OF DUPLICATE CULTURES OF BLOTCH-LEAF MAIZE GROWN IN SUCCESSIVE SEASONS

Year	Distribution of plants with respect to blotch grades								Total number of plants	Mean grade	
	0	1	2	3	4	5	6	7		All plants	Blotched plants
1918	47	3	6	13	13	6	2	0	90	1.64 ± 0.14	3.44 ± 0.13
1919	42	2	11	14	13	4	2	0	88	1.70 ± 0.13	3.26 ± 0.12
Difference										−0.06 ± 0.19	+0.18 ± 0.18

In contrast with the marked similarity between the grades assigned the duplicate cultures shown in table 1, the difference between two distinct pedigree cultures, grown in the same year and noted at about the same time, is shown in table 2:

TABLE 2. COMPARISON OF DISTINCT PEDIGREE CULTURES OF BLOTCH-LEAF MAIZE GROWN IN THE SAME SEASON

Pedigree no.	Distribution of plants with respect to blotch grades								Total number of plants	Mean grade
	0	1	2	3	4	5	6	7		
6652	..	..	..	3	12	9	14	3	41	5.05 ± 0.12
6700	..	15	18	5	4	3	4	2	51	2.65 ± 0.16
Difference										2.40 ± 0.20

EFFECT OF STRONG SUNLIGHT ON BLOTCH LEAF

The probability that blotch leaf is an inherent weakness of certain plants or strains of maize, the expression of which is influenced by light intensity, has been mentioned. The first indication of this came from a few plants grown in the greenhouse in winter. They developed almost no blotch, tho a duplicate culture grown in the open the preceding summer had shown strong blotch on all plants. Another duplicate lot of these plants grown the following summer also developed strong blotch.

In the summer of 1918, a test was made of the effect of partial shade on the development of blotch. Four pedigree cultures were included in the test. One planting of each was made in the garden on May 15. These cultures were exposed to full sunlight thruout the summer. On June 24, duplicate plantings were made in the garden and in the greenhouse. About half the plants of these later plantings were exposed to full sunlight, except in so far as the glass of the greenhouse cut down the light intensity for the plants grown inside. The other half of both the garden and greenhouse lots were given partial shade. A screen consisting of two thicknesses of No. 9C Saxolin, a coarsely woven paper cloth, was hung a few feet above the tops of the plants. In addition to the greatly reduced light reaching the plants thru this screen, they received diffused light from all sides, and, in early morning and late afternoon, direct sunlight from the sides. The screen was erected when the plants were about a month old. Final notes were made on September 10, when the early-planted garden plants were nearly four months, and the late-planted garden and greenhouse plants were about two and a half months, from planting.

The ranges of distribution of the plants of the several lots with respect to grades of blotch are shown in table 3. The number of plants of the several grades was not recorded, but the ranges of the plants with respect to grade of blotch are of interest.

Comparison of groups 1 and 2a shows that there are no material differences in development of blotch between the early-planted and the late-planted garden plants exposed to full sunlight. Such differences as were observed might well have been due to the small numbers of plants involved. As between the garden plants in full sunlight and those in shade, groups 2a and 2b, however, there was a noticeable difference. On the whole, the shaded plants exhibited much less blotch than did the plants in direct sunlight, only one pedigree, 8163, showing overlapping ranges. Similar differences were observed between the sun and the shade plants in the greenhouse, groups 3a and 3b. Here again pedigree 8163 was the only one that showed overlapping in ranges of blotch grades. The greenhouse plants of two pedigrees, 8174 and 8175, showed somewhat less well-developed blotch than did the garden plants. The plants of

TABLE 3. EFFECT OF SHADE AND OF FULL SUNLIGHT ON THE DEVELOPMENT OF BLOTCH LEAF

Group	Environment	Pedigree no.	Distribution of plants with respect to blotch grades							Total number of plants
			1	2	3	4	5	6	7	
1	Garden Early planting Sun	8163				←	—	—	→	11
		8164					←	—	→	5
		8174					←	—	→	12
		8175				←	—	→		10
2a	Garden Late planting Sun	8163				←	—	—	→	4
		8164						↔		2
		8174						←	→	5
		8175					←	→		4
2b	Garden Late planting Shade	8163			←	—	→			4
		8164			↔					2
		8174			←	→				5
		8175			←	→				4
3a	Greenhouse Sun	8163					←	—	→	5
		8164						←	→	4
		8174					←	→		5
		8175			←	—	→			4
3b	Greenhouse Shade	8163				←	→			5
		8164			←	—	→			5
		8174		←	—	→				4
		8175	←	→						4

pedigrees 8163 and 8164, on the contrary, were slightly less blotched in the garden than in the greenhouse.

While the numbers of plants dealt with are small, the effect of partial shade in lessening the intensity of blotch leaf is strongly suggested by the results of these tests. Since temperature and humidity were not controlled in these tests, there is no conclusive evidence as to whether shade exerts its effect directly, or only indirectly thru its influence on temperature and humidity.

ORIGIN OF BLOTCH LEAF

There is reason to believe that the blotch-leaf character arose as a bud mutation in a single plant grown in 1911. This assumption is based on the following considerations. Blotch appeared first in two cultures grown in 1914, one having 8 well-blotched and 23 non-blotched plants,

and the other having 9 blotched and 35 non-blotched plants. These cultures came from two inbred plants, 2420-1 and 2421-2, grown in 1913. Neither of these plants showed blotch, nor did any of their sibs, but both were evidently heterozygous for this recessive character. That at least one of their sibs, 2421-1, was not heterozygous is shown from the fact that of its offspring produced by selfing, 28 plants in all, none exhibited blotch. The plants of cultures 2420 and 2421 were F_1's of two crosses, 2002-1 x 2003-21 and 2002-5 x 2003-21, respectively. Neither of these three plants was blotched, but evidently either both of the sibs 2002-1 and 2002-5 were heterozygous for blotch, or the unrelated plant 2003-21 used in both crosses was heterozygous.

Unfortunately, neither of these three plants was self-pollinated, so that there is no direct evidence of heterozygosity on the part of any one of them. Since plant 2003-21 was used in both crosses, it is natural to suppose that it may have been the heterozygous parent. This assumption, however, is disproved by the following facts. It was used in a third cross, 2031-20 x 2003-21, resulting in 133 F_1 plants, all normal. Of these F_1's, 12 produced by self-pollination 1564 F_2 plants, not one of which showed any indication of blotch. If plant 2003-21 had been heterozygous, some of its F_2 progenies—theoretically 6 of the 12—should have thrown some blotched offspring. There is scarcely more than 1 chance in 2000 that this plant could have been heterozygous without some of its 12 F_2 progenies showing blotch. It is of interest to note that plant 2003-21 was one of 25 normal sibs occurring in a culture which was the result of two generations of selfing of a plant of Black Mexican sweet corn.

Therefore the other two plants used in the crosses that threw the first observed blotched individuals, 2002-1 and 2002-5, must both have been heterozygous for blotch. They belonged to a culture of 68 normal plants grown in 1912 from the self-pollinated plant 1312-59. This plant could not itself have been heterozygous, else it would have thrown some blotched offspring. But since at least two of its offspring—the only ones tested—were heterozygous, more than one of its germ cells, presumably several of them, must have carried the gene for blotch. We must assume, therefore, either (1) that a bud mutation occurred late in the development of this plant, thus affecting tissue from which more than one pollen grain or more than one egg cell arose but not affecting the entire plant, or (2) that at least two separate mutations occurred among its germ cells. The former seems the more reasonable assumption.

It may not be without interest to note that the plant in which this bud mutation is assumed to have occurred was one of 293 normal individuals grown in 1911 from a self-pollinated plant of a cross of Purple Pop corn with Northwestern Dent corn. Both of these parent plants were from self-pollinated parents of the varieties noted, their sibs, 58 in

one case and 64 in the other, being, like themselves, wholly without indication of blotched leaves.

INHERITANCE OF BLOTCH LEAF

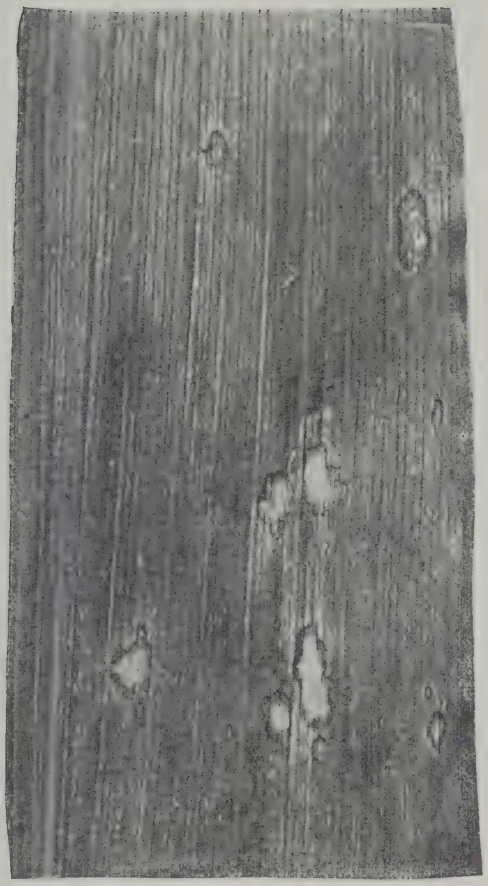
Crosses of homozygous blotch leaf with normal have in general given non-blotched F_1 plants. Occasionally, however, slightly blotched plants have been observed. Of 786 plants of twenty-four F_1 progenies, 13 were assigned blotch grade 2 and 62 blotch grade 1, the remaining 711 being classed as without blotch, grade 0. Blotch leaf may therefore be regarded, for practical purposes, as a recessive character under the environmental conditions to which the writer's cultures have been subjected. There is, however, a slight tendency toward partial dominance of blotch.

A total of thirty-two F_2 progenies, including 1721 individuals, have been observed, and the results are given in table 4. In all of these lots, blotched plants appeared together with normal ones. Since the male parent of some and the female parent of others of these F_2 progenies were blotched, it follows that the character is transmitted thru either pollen or eggs.

The distribution of these F_2 plants with respect to grades of blotch is as follows:

Blotch grade	0	1	2	3	4	5	6	7	Total
Frequency	1043	182	196	126	92	30	36	16	1721

If the non-blotched plants are placed in one group and all the plants having any blotch whatever in a second group, the non-blotched are to the blotched as 1043:678. Since, however, some F_1 plants were recorded as of blotch grades 1 and 2, it might well be supposed that at least some of the F_2 plants of these grades were heterozygous for the normal allelomorph of blotch. Since the real nature of plants graded as 1 and 2 cannot be determined except by individual breeding tests, and since some plants, but not all of those tested, of both these grades have been found to be heterozygous, it may be allowable, for a tentative comparison, to group arbitrarily all plants of grade 1 with the wholly normal plants. This has been done in most of the later linkage tests involving blotch leaf. Among the F_2 plants, grades 0 and 1 together were represented by 1225 individuals, and grades 2 to 7 inclusive by 496 individuals. This is a deviation from the 3:1 relation expected on the basis of a single differential factor pair, of 65.8 ± 12.1. While this is not a close fit to a 3:1 relation, it is perhaps sufficiently near, considering the arbitrary grouping resorted to, to suggest that a single factor pair is the primary agent in producing the basal difference between blotch and non-blotch.



BLOTCH LEAF OF MAIZE

Each blotch is bordered by reddish pigment, which shows as a dark ring in the photograph

GRADES OF BLOTCH LEAF

Grade 7, with numerous large blotches, is shown at the left, and grade 1, with a few very small blotches, at the right. The light areas around the blotches on the leaf at the left are due to the absence of anthocyanic pigment, which is present in the other parts of the leaf

VARIATION IN SIZE OF BLOTCHES

The plant from which the leaf at the right was taken had small blotches thruout, while the one represented by the leaf at the left had mainly large blotches

TABLE 4. F_2 PROGENIES OF CROSSES OF BLOTCHED WITH NON-BLOTCHED PLANTS

Pedigree no.	Distribution of plants with respect to blotch grades								Total number of plants
	0	1	2	3	4	5	6	7	
2904	8	7	8	..	4	..	4	..	31
2908	19	9	7	..	2	..	3	4	44
5290	106	27	14	11	10	3	3	..	174
6671	54	14	6	11	2	..	..	..	87
6675	33	19	17	3	4	..	4	2	82
6679	28	18	23	14	8	2	3	..	96
6689	33	4	1	5	1	2	1	4	51
6692	86	24	17	13	7	..	..	..	147
6696	36	6	3	7	4	..	1	..	57
6858	8	2	2	1	..	..	..	..	13
6860	7	2	2	..	1	1	..	..	13
7132	69	6	6	2	4	2	4	2	95
7365	43	4	4	1	..	..	..	..	52
7366	12	1	2	3	1	..	..	..	19
7367	10	4	5	..	..	1	..	..	20
7368	24	4	11	2	4	..	..	..	45
7369	21	9	6	8	4	1	..	..	49
7373	16	1	..	3	..	..	..	..	20
7374	26	1	6	4	..	..	..	..	37
7375	25	3	5	3	2	..	..	..	38
7376	15	..	6	3	2	2	..	..	28
7377	6	..	3	1	..	..	..	..	10
7378	28	..	7	3	..	..	..	..	38
7379	51	..	10	5	3	2	1	..	72
7380	53	2	3	7	1	1	2	..	69
7381	56	2	14	4	2	2	1	1	82
8160	4	..	..	..	1	2	3	..	10
8178	5	1	3	..	2	1	2	1	15
8180	16	4	3	..	2	2	1	..	28
10591	43	1	1	3	5	1	1	1	56
10596	80	..	..	6	14	4	2	..	106
11811	22	7	1	3	2	1	..	1	37
Total, 32 progenies	1,043	182	196	126	92	30	36	16	1,721

Mean grade of blotched plants = 2.65 ± 0.04

In addition to the F_2 data presented above, records are available for twenty-two progenies of F_1 plants backcrossed to recessive strong blotch. These records are given in table 5:

TABLE 5. PROGENIES OF CROSSES OF BLOTCHED WITH NON-BLOTCHED PLANTS, BACKCROSSED WITH BLOTCHED PLANTS

Pedigree no.	Distribution of plants with respect to blotch grades								Total number of plants
	0	1	2	3	4	5	6	7	
7328	37	8	6	6	5	3	5	2	72
7330	67	25	14	24	23	19	13	8	193
7332	54	19	21	18	16	12	7	1	148
7334	21	1	6	14	3	2	2	..	49
7345	25	1	4	4	1	..	4	1	40
7347	132	22	50	37	26	11	6	..	284
7335	18	6	7	1	8	5	10	3	58
7336	45	13	15	15	10	3	2	..	103
7337	19	3	3	5	6	3	..	..	39
7338	9	4	1	4	2	4	1	..	25
7339	20	7	5	5	5	3	3	1	49
7340	12	4	10	7	4	2	3	..	42
7341	65	13	22	22	18	14	12	4	170
7344	27	11	6	8	7	5	5	7	76
7349	53	6	9	9	16	9	6	2	110
7357	6	2	..	2	1	1	6	..	18
8151	12	5	3	2	2	3	3	1	31
8153	44	13	2	5	15	24	25	5	133
8155	60	5	11	14	16	11	6	2	125
8157	89	5	17	27	26	10	4	..	178
9241	107	28	34	28	20	10	6	2	235
9242	128	22	34	28	26	9	5	1	253
Total, 22 progenies ...	1,050	223	280	285	256	163	134	40	2,431

Mean grade of blotched plants = 3.30± 0.03

The distribution of these backcross plants with respect to grade of blotch is as follows:

Blotch grade	0	1	2	3	4	5	6	7	Total
Frequency	1050	223	280	285	256	163	134	40	2431

If here, again, grades 0 and 1 be grouped together as non-blotched and grades 2 to 7 inclusive as blotched, the numerical relation of the two groups is 1273:1158. This is a departure of 57.5 ± 16.6 from the 1:1 relation. Perhaps this is as near equality as could be expected from so arbitrary a grouping.

From the F_2 and backcross behavior, it seems probable that there is a single pair of genetic factors which is the primary agent in the development of blotch leaf. This pair has been designated *Bl bl*.

The behavior in F_3 of such F_2 plants as have been tested is shown in table 6. Where F_3 progenies exhibited a distribution of blotch grades similar to F_2's, the F_3 plants are regarded as equivalent to F_2's and their F_4 progenies are included in the table.

TABLE 6. F_3 AND F_4 PROGENIES OF F_2 AND EQUIVALENT F_3 PLANTS

Group	Pedigree no.	Blotch grade of parent	Distribution of plants with respect to blotch grades								Total number of plants
			0	1	2	3	4	5	6	7	
1	5253	0	17	..	..	..	..	..	..	..	17
	6710	0	38	..	..	..	..	..	..	..	38
	6719	0	50	..	..	..	..	..	..	..	50
	6863	0	8	..	..	..	..	..	..	..	8
	Total, 4 progenies		113	..	..	..	..	..	..	..	113
2	5245	0	5	4	1	3	..	..	..	..	13
	5274	0	94	21	7	2	8	..	..	..	132
	6687	0	7	9	6	3	..	..	2	1	28
	6714	0	10	6	5	2	..	..	..	..	23
	6717	0	4	8	5	3	..	..	..	..	20
	6718	0	2	9	2	2	1	..	..	..	16
	6862	0	2	1	..	..	..	..	1	..	4
	7382	0	52	3	6	..	..	..	..	..	61
	Total, 8 progenies		176	61	32	15	9	..	3	1	297
3	5257	1	13	4	2	..	2	..	..	..	21
	5280	1	18	21	7	..	7	2	5	4	64
	6669	1	20	18	6	2	1	2	5	..	54
	6711	1	30	22	8	6	2	4	2	..	74
	6713	1	8	11	5	..	..	..	..	..	24
	7383	1	52	2	6	3	3	3	..	..	69
	Total, 6 progenies		141	78	34	11	15	11	12	4	306
4	6683	1	3	9	19	14	7	5	7	7	71
	6700	1	..	15	18	5	4	3	4	2	51
	6702	1	1	1	6	1	..	..	..	..	9
	6715	1	..	13	12	1	..	..	..	..	26
	Total, 4 progenies		4	38	55	21	11	8	11	9	157
5	5247	2	11	13	2	2	2	..	..	..	30
	5270	2	12	12	6	1	2	2	..	..	35
	Total, 2 progenies		23	25	8	3	4	2	..	..	65
6	5265	2	1	17	17	13	10	2	1	..	61
7	6667	3	..	9	19	20	4	..	..	..	52
	7362	3	..	..	2	6	7	4	3	..	22
	Total, 2 progenies		..	9	21	26	11	4	3	..	74

TABLE 6 (*concluded*)

Group	Pedigree no.	Blotch grade of parent	Distribution of plants with respect to blotch grades								Total number of plants
			0	1	2	3	4	5	6	7	
8	5278	4	..	4	11	8	9	4	2	..	38
	6692	4	..	..	..	1	9	8	8	3	29
	Total, 2 progenies		..	4	11	9	18	12	10	3	67
9	6703	5	..	..	..	..	2	8	6	3	19
10	6664	6	..	..	..	..	5	20	58	50	133
11	5251	7	..	..	1	4	3	1	4	3	16
	7364	7	..	..	..	1	5	9	13	3	31
	Total, 2 progenies		..	..	1	5	8	10	17	6	47

In groups 1 and 2 of table 6 are recorded all the progenies grown from F_2 and equivalent F_3 plants that had been recorded as free from blotch, grade 0. Four of these (group 1) produced only non-blotched plants, while eight (group 2) threw both blotched and non-blotched individuals. That one-third of such plants should breed true and two-thirds prove to be heterozygous is in accord with the assumption that the single factor pair, *Bl bl*, differentiates blotched from normal plants. The distribution of the individuals of the eight progenies in group 2 to the several blotch grades is as follows:

Blotch grade	0	1	2	3	4	5	6	7	Total
Frequency	176	61	32	15	9	0	3	1	297

If the plants of grades 0 and 1 be arbitrarily classed as normal and those of grades 2 to 7 as blotched, the numerical relation between the two classes is 237:60, a deviation of 14.2 ± 5.0 from the 3:1 relation.

All the progenies grown from F_2 or equivalent F_3 plants that had been recorded as of blotch grade 1 are listed in groups 3 and 4 of table 6. Six of these progenies (group 3) produced blotched and non-blotched plants distributed as follows:

Blotch grade	0	1	2	3	4	5	6	7	Total
Frequency	141	78	34	11	15	11	12	4	306

The individuals of grades 0 and 1 are to those of grades 2 to 7 as 219:87, a deviation of 10.5 ± 5.1 from the 3:1 relation. Four progenies from grade 1 parents (group 4) showed quite different behavior. The distribu-

tion of the individuals of these progenies to the several blotch grades is as follows:

Blotch grade	0	1	2	3	4	5	6	7	Total
Frequency	4	38	55	21	11	8	11	9	157

Here the plants of grades 0 and 1 are to those of grades 2 to 7 as 42:115, not far from a 1:3 relation. It is improbable, however, that any significance is to be attached to this relation. It seems more likely that some plants which are genotypically homozygous for blotch, *bl bl*, may, under certain conditions, fail to develop blotches.

Three progenies grown from F_2 plants that had blotch designated as of grade 2 are entered in groups 5 and 6 of table 6. The two progenies of group 5 were much like those of group 3, and the one progeny of group 6 was similar to the progenies of group 4. If the plants of grades 0 and 1 be combined into one class and those of grades 2 to 7 into another, the progenies of groups 5 and 6 were made up of normal and blotched plants in the ratios of 48:17 and 18:43, respectively. It is obvious, from this, that some F_2 plants which show slight blotch, grades 1 and 2, are none the less heterozygous for the normal allelomorph of the blotch gene, *Bl bl*. It will be recalled that some such plants were found in F_1 also. Evidently blotch is not wholly recessive under all conditions. It seems apparent also that not all F_2 plants of grades 1 and 2 have the normal allelomorph of blotch. Since there is ordinarily a wide range of variation in the intensity of blotch, it seems possible that plants homozygous for the blotch gene may in some cases show very slight or even no blotch.

In groups 7 to 11 of table 6 are listed eight progenies grown from plants that had grades of blotch from 3 to 7. No wholly non-blotched (grade 0) plants were produced in any of these groups, and only a few grade 1 plants were observed. In so far, therefore, as a test of eight plants can be expected to give reliable indications, these tests indicate that plants of blotch grade 3 or above are homozygous for the blotch gene, *bl bl*.

FACTORS MODIFYING BLOTCH LEAF

In the foregoing account, attention has been called repeatedly to the fact that blotch leaf is highly variable in regard to the intensity of its expression. How much of this variation may be due to environmental effects is not known, but it has been shown that the intensity of sunlight has a modifying influence. It seems likely that hereditary differences also may play a part. The data presented in groups 4, 6, 7, 8, 9, 10, and 11 of table 6, including all progenies the parents of which are assumed to have been homozygous, *bl bl*, favor the contention of a hereditary effect. The subtotals of these groups are shown in table 7:

TABLE 7. VARIATION IN BLOTCH INTENSITY IN HOMOZYGOUS BLOTCHED PROGENIES GROWN FROM F_2 AND EQUIVALENT F_3 BLOTCHED PLANTS

Blotch grade of parent	Distribution of plants with respect to blotch grades									Mean grade
	0	1	2	3	4	5	6	7	Total	
1	4	38	55	21	11	8	11	9	157	2.70 ± 0.10
2	1	17	17	13	10	2	1	..	61	2.39 ± 0.11
3	..	9	21	26	11	4	3	..	74	2.85 ± 0.10
4	..	4	11	9	18	12	10	3	67	3.97 ± 0.13
5	..	..	..	..	2	8	6	3	19	5.53 ± 0.14
6	..	..	..	..	5	20	58	50	133	6.15 ± 0.05
7	..	..	1	5	8	10	17	6	47	5.17 ± 0.13

While there are irregularities in table 7, as might be expected owing to the small numbers involved in some cases and to the difficulties of classification, there is a definite indication that, in general, the higher the grade of blotch of the parent plant, the higher is the mean grade of the progeny. Altho the difference in grade between some progenies is not statistically significant, the difference in grade of the progenies from parents of grade 1 and from parents of grade 7 is 2.47 ± 0.16.

Much the same results are shown in table 8, in which are presented the available data of F_4 and F_5 progenies with a history of one and two previous generations of homozygosity of the *bl* gene. The progenies are arranged in the table in the order of the grade of blotch of their respective parents, the parents of the culture shown in group 1 having been of blotch grade 2, and the parents of the cultures of group 5 having been of blotch grade 7. In these groups there is a somewhat irregular, but on the whole progressive, increase in the mean grade of the progenies, from 3.60 ± 0.13 to 5.52 ± 0.09 as the grade of the parents increased from 2 to 7, or a difference of 1.92 ± 0.16. The grade of the grandparents in groups 1 to 5 was 7 in all but two cases.

In group 6 of table 8 are listed three small cultures whose parents were of grade 7, whose grandparents were of grades 4, 7, and 7, respectively, and whose great-grandparents were all of grade 7. The mean grade of these three cultures is 6.39 ± 0.06. This rather intensive selection for high-grade blotch for three generations has apparently established high-grade blotch strains with little variation in grade of blotch.

The data in tables 7 and 8 strongly suggest that much of the variation in intensity of blotch is hereditary. But the results in F_2 and F_3 indicate that the occurrence or non-occurrence of blotch is due primarily to a single pair of genetic factors, *Bl bl*. It is assumed, therefore, that in

TABLE 8. VARIATION IN BLOTCH INTENSITY IN HOMOZYGOUS BLOTCHED PROGENIES GROWN FROM PLANTS OF WHOLLY BLOTCHED CULTURES

Group	Pedigree no.	Blotch grade of parents			Distribution of plants with respect to blotch grades							Total number of plants	Mean grade
		P_1	P_2	P_3	1	2	3	4	5	6	7		
1	6704.....	2	4	0	..	3	13	9	3	2	..	30	3.60± 0.13
2	6658.....	3	7	0	..	5	12	18	10	7	5	57	4.30± 0.12
3	6652.....	4	7	0	..	..	3	12	9	14	3	41	
	6708.....	4	7	0	..	1	10	12	10	3	1	37	
	6705.....	4	4	0	..	..	3	6	8	4	..	21	
	Total, 3 progenies.....				..	1	16	30	27	21	4	99	4.64± 0.08
4	6709.....	6	7	0	..	..	3	14	14	7	..	38	4.66± 0.09
5	6648.....	7	7	0	..	..	..	..	10	22	17	49	
	6706.....	7	7	0	..	..	6	8	11	5	..	30	
	Total, 2 progenies.....				..		6	8	21	27	17	79	5.52± 0.09
6	7192.....	7	4	7	..	..	..	..	..	7	6	13	
	10584.....	7	7	7	..	..	..	..	..	3	3	6	
	10587.....	7	7	7	..	..	..	..	..	10	4	14	
	Total, 3 progenies.....				..	..	..	..	..	20	13	33	6.39 ± 0.06

addition to the basal gene for blotch, *bl*, there exist modifying factors which influence the intensity of blotch but which are without effect, or have very little effect, in the presence of the normal allelomorph of blotch *Bl*.

If this assumption is correct, different stocks of normal plants should be found to carry different modifying factors. This, in turn, should result in different distributions of the F_2 plants with respect to blotch grades. An inspection of the F_2 progenies recorded in table 4 shows that such differences were observed. Moreover, F_1's backcrossed to strongly blotched plants should give progenies with a higher grade of blotch than F_2 progenies. While the backcross data of table 5 are not wholly comparable with the F_2 data of table 4, it is of interest to note that the mean grade of all F_2 blotched plants was 2.65 ± 0.04, while that of all backcross blotched plants was 3.30 ± 0.03, a difference of 0.65 ± 0.05.

SUMMARY

The blotch-leaf character of maize is manifested by the presence, principally on the leaves, of blotches of a yellowish color, a considerable part of the tissue of which usually dies. The blotches vary greatly in size and number. Blotch leaf is thought to be due to a weakness of certain plants. Its intensity has been shown to be increased by strong sunlight and correspondingly lessened by shade.

The character is thought to have originated as a somatic mutation in a single plant.

Blotch leaf is inherited as a recessive, or nearly recessive, character. If the blotched plants of the lowest grade, such as often occur in F_1, are grouped with the normals, F_2 progenies consist of normal and blotched plants in approximately a 3:1 ratio and backcross progenies in approximately a 1:1 ratio. These facts lead to the interpretation that blotch is due to the effect of a single pair of factors, *Bl bl*. The F_3 behavior is in accord with this hypothesis.

Great variations in the grade of blotch have been observed. Selection experiments with plants of diverse grades of blotch of F_2 and later generations show that these variations are inherited, at least in part. These results are interpreted as due to the action of modifying factors which are assumed to influence the intensity of blotch but which are without effect in the presence of the normal allelomorph of the blotch gene.

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AGRICULTURAL EXPERIMENT STATION

SOME STUDIES ON THE NEUTRALIZATION OF CREAM FOR BUTTER-MAKING

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SOME STUDIES ON THE NEUTRALIZATION OF CREAM FOR BUTTER-MAKING

H. C. Jackson

The principle of neutralization in relation to dairy products has been applied in practice for a number of years. It is not definitely known when it was first applied in the creamery. Flint (1858) speaks of adding a solution of soda and water to milk to retard the formation of acidity. He claims that this will increase the product of the butter and improve its quality. In a letter to the writer, Professor F. W. Bouska states that Professor G. L. McKay conducted some experiments along this line in the winter of 1901–02. It seems to be the opinion among creamery operators that the addition, before pasteurization, of an alkali or an alkaline earth to very sour cream, improves the flavor of the butter churned from it.

The results of studies of some of the factors involved in neutralizing cream, and of the effect of neutralization on the butter, are discussed in this memoir.

REVIEW OF LITERATURE

Rogers (1904) found that in twelve samples of fresh butter the average number of bacteria was about 5,351,130 per gram, and at the end of 116 days the number had been reduced to 675.

Rogers and Gray (1909) claim that "the deleterious effect of high acidity was not due to any organism, enzyme, or other substance which can be destroyed by heat," and that it is probable that lactic acid itself has a marked effect on the flavor of butter.

Lythgoe and Marsh (1910) found that as the fat increases in cream, the calcium decreases. The maximum CaO and fat ratios are as follows: 0.181:15, 0.169:20, 0.156:25, 0.144:30, 0.132:35, 0.120:40, 0.108:45, 0.096:50, 0.085:54.

Dean (1913) reports that "butter scored about three points higher by adding milk-lime to the cream before pasteurizing, and three-and-a-half points higher by adding the milk-lime after pasteurization, as compared with the scores of butters from similar lots of cream which were not neutralized." The use of a small quantity of concentrated milk of lime proved preferable to that of a large quantity of limewater.

Ramsay (1915) describes the neutralizing and pasteurizing process. He reduces the excess acidity to 0.2 per cent with sodium bicarbonate or washing soda. He states that neutralization results in the formation of the sodium salt of the organic acids and in the liberation of carbon dioxide. The viscosity of the cream is lessened when the cream is heated to 170° F., as in pasteurizing, and the carbon dioxide then rises and escapes into the air. The author claims that unpleasant odors and taints are removed. He states further that, other things being equal, it appears justifiable to expect somewhat less curd in butter made from neutralized

cream than in that from untreated cream, and that there is approximately no change in the composition of the butter.

Wichmann (1917) states:

> The percentage of calcium oxid in the ash of milk, unneutralized cream, and butter made from unneutralized cream varies within fairly narrow limits, with a tentative maximum set at 25.
>
> When lime has been added to the cream in the process of manufacture this percentage is increased above 25, the increase varying with the amount of lime added and the degree of washing.
>
> The effect of calcium impurities in the salt has been studied and a method developed to correct for the chief impurity, calcium sulphate.
>
> It has been shown that the percentage of calcium oxid in the salt-free ash of butter made from unneutralized cream will not exceed the tentative maximum limit of 25, unless high percentages of salt with much impurity are employed.

Wichmann deals primarily with the detection of neutralized-cream butter, and does not enter into the details of manufacture.

Giltner [and Brown] (1917) conducted the following experiment on cream. A vat of sour gathered cream was divided into two lots, one of which was neutralized with lime and the other left untreated. Each lot was pasteurized in a vat pasteurizer at 145° F. for twenty minutes, and then cooled. About 10 per cent of starter was added to each lot, and they were churned at the same time in separate churns. Samples were taken from the churns just before salting, and other samples just after salting. The samples were placed in paraffined paper containers and set in storage at 32° F. for 315 days. The butter when fresh scored as follows: sour-cream, 89; neutralized-cream, 90. The samples were analyzed at the end of the storage period for changes in acidity, moisture, bacteria count, amino nitrogen, and nitrogen in proteoses and peptones. The authors state that "butter from neutralized cream although not showing uniformly greater changes is less desirable for storage." The unsalted samples were high in water-soluble acid, and in proteoses and peptones.

Frandsen, Mortensen, Hines, and Bouska (1917) made a report to the official Dairy Instructors Association at Chicago, on the subject of neutralization. The report deals with a questionnaire which had been sent out to leading dairymen in the colleges and in practical work. The answers to this questionnaire show that lime was considered most desirable and was most commonly used. The report includes the following table:

TABLE 1. LIME CONTENT OF BUTTER AS DETERMINED BY BOUSKA AND BROWN

	Casein (per cent)	Lime (per cent)
1. Raw, very sour cream, no lime added	1.18	0.065
2. Country butter	1.31	0.004
3. Country butter	1.60	0.112
4. Country butter	1.00	0.053
5. Moderately sour, slightly neutralized with lime	0.69	0.068
6. Moderately sour, slightly neutralized with lime	1.24	0.065
7. Very sour, neutralized with lime	0.95	0.067
8. Very sour, excessively neutralized with lime	1.16	0.126

Combs and Eckles (1917) believe that "a study of the cream is more likely to yield results, when the action of microorganism is suspected, than is a study of the butter." They come to the following conclusions:

> Mold spores do not germinate or make growth in butter. The growth of mold on butter is the result of a contamination from the outside.
>
> Pasteurization at ordinary temperatures greatly improves the keeping qualities of butter made from cream upon which molds have made growth but it does not entirely check the action of the enzymes which they produce. This action may be checked entirely by heating to a sufficiently high temperature but this point is beyond the limit of practicability for commercial use.
>
> The abnormal flavors which develop in butter, due to mold growth on the cream, are caused by enzymes which are secreted by the mold in the cream.

O'Callaghan and Ramsay (1918) give their observations on the viscosity of cream neutralized with slaked lime, and the chemical composition of butter made from such cream after pasteurization. The cream became thickened without regard to its age, acidity, or fat content, but became thinner on pasteurization. It was found that the lime content of butter manufactured from cream in which lime had been used as the neutralizing alkali, fell within the average lime content of ordinary butter.

Bouska, in a letter to the author, states that there is little danger of undesirable bacteria being present to any appreciable extent in manufactured butter after the cream has been thoroughly pasteurized.

INVESTIGATIONAL WORK

Experiments with various neutralizers

In the preliminary work, CaO, MgO, Na_2CO_3, $NaHCO_3$, and NaOH were used as neutralizing agents. The method consisted in accurately weighing 350 grams of cream into a glass beaker and transferring it to an ordinary quart milk bottle, in which the neutralizing and pasteurizing was done. Five bottles of cream were weighed out, and were neutralized with CaO, MgO, Na_2CO_3, $NaHCO_3$, and NaOH, respectively. A sixth bottle was run as a check on the other five. The acidity of the cream was determined by titrating a 50-cubic-centimeter sample with tenth normal NaOH, phenolphthalein being used as indicator. An attempt was made to reduce the acidity to 0.25 per cent, calculated as lactic acid. The amount of alkali necessary to reduce the acidity was calculated according to the following proportion: the molecular weight of lactic acid is to the molecular weight of alkali used, as the actual weight of lactic acid to be neutralized is to x, the amount of alkali used. For bivalent compounds, such as calcium oxide, $x/2$ was used.

The neutralizing agent was weighed out in a small beaker, and was added to the cream either in a solution of water or in a partial solution as with MgO and CaO. The cream was well agitated while the alkali was being introduced. The bottles of cream were pasteurized at 145° F. for twenty-five minutes by partially immersing them in a tub of water heated with steam. The bottles were agitated during the heating and holding process. After cooling, the cream was kept at a temperature of 50° F. overnight, and was then transferred to other glass bottles which had been thoroughly washed and scalded. These bottles were then placed in a box

and churned in a cradle churn. An acid test was made on each sampl before churning.

No color was added to the cream, for it was considered that this migh affect the flavor somewhat. The cream was churned until the butte granules were the size of pop-corn seed. The buttermilk was drained of and the butter was washed twice with water at 56° F. The butte was salted and was then worked on a butter board, a straight woode ladle being used. Samples were taken from each lot, wrapped in vege table parchment paper, and properly labeled. These were placed in th refrigerator at 50° F. overnight, and were scored on the following day Before the scoring, the labels on the papers were turned under and num bers were placed on the papers. In this way the identity of the butte was not known by the judges. Each judge worked independently through out the scoring and this system was followed in each experiment.

The results from these preliminary tests showed that CaO was slightly better than any other neutralizing agent used. The butter from th cream treated with the soda compounds had a bitter and soapy taste while that from the cream treated with magnesium, invariably tasted lik carbolic acid. It was noted that there were usually small white speck in the butter when the cream was neutralized with magnesium. The sod compounds gave much trouble during pasteurization because of foamin due to the liberation of carbon dioxide.

The neutralized samples never scored more than two points highe than the check sample. The results seemed to indicate that neutraliza tion did but little good. This may be accounted for by the fact that th cream was not of the type that is usually neutralized. The samples were all of rich cream, testing over 40 per cent fat, and had been held at 35° F for a long period for the purpose of ice-cream making. The cream had soured at this low temperature and possessed the bitter flavor character istic of cream held at low temperatures. The neutralizing did not remov this flavor.

It was decided as a result of this study to use calcium lime as a neu tralizing agent, and to continue the investigation with larger amounts o cream.

Experiments with larger amounts of cream

The cream used in this part of the work was taken from some which had been delivered to a station from cream routes, and was sour when received. The pasteurization was accomplished as in the preceding experiment, except that shotgun pails, provided with stirrers, were used in the place of bottles. The cream was churned in hand churns (Babcock No. 1), and the butter was washed and worked in the usual manner. Samples of butter were taken before and after salting, and were judged on the following day.

This time a different method was used in preparing the lime mixture before adding it to the cream. The amount of lime was calculated as already described. The lime was weighed out and crushed, and about a 15-per-cent mixture with water was made. This was boiled over a Bunsen flame for about ten minutes. Water was added until the lime was nearly all in suspension and no large lumps remained in the bottom of the container. The results, shown in table 2, indicate that the neutralized salted

TABLE 2. AVERAGE RESULTS OBTAINED WITH CREAM NEUTRALIZED WITH CaO

Sample	Average fat in cream (per cent)	Average acidity before neutralizing (per cent)	Average acidity before churning (per cent)	Average score of salted butter	Average score of unsalted butter
Unneutralized	25.5	0.70	....	90	90
Neutralized	25.5	0.70	0.28	92	91

butter averaged two points higher in flavor than the unneutralized, and that the neutralized unsalted butter was only one point higher than the unneutralized. It is realized that 90 is rather a high score for butter made from cream that has had to be neutralized.

Bacteriological investigation of cream

At this point in the investigation it was thought that a bacteriological study of the cream to be neutralized might possibly reveal some important facts. Large quantities of cream are shipped long distances, and, in the summer months, frequently arrive at the creamery in poor condition. However, a fairly good grade of butter is made from this cream when it is neutralized and pasteurized. The butter will often score from 90 to 91. Factory conditions were simulated as closely as possible in carrying out further experiments. The milk from which the cream was separated was generally two days old at the time of separation. It usually was in poor condition, possessed a strong, cowy, old flavor, and was gassy. Immediately following each separation, a sample of cream was taken for bacteriological examination. The cream (about 40 pounds) was divided into two equal lots, one of which was held at a temperature of 55° to 60° F. and the other at 70° to 75° F. Each lot was held for an average period of six days before being churned; the longest period was fourteen days and the shortest was three. Mold developed on the surface in some of the samples, while others became gassy and developed a yeast-like odor. No attempt was made to provide sterile containers for the cream, because pails are rarely sterile under farm conditions. The cream was held in shotgun pails which had been thoroughly washed and scalded. These pails are of small diameter and will hold about 35 pounds of cream. Papers were tied over the tops of the pails to keep out dirt. Small holes were punched in the papers to permit some circulation of air.

The cream held at a temperature of from 55° to 60° F. was considered as representing that on a farm where the farmer was endeavoring to keep his cream in good condition. The other lot, held at a higher temperature, was to represent cream that had received hardly any care, other than being put in a clean pail. Ten samples were divided and held in this manner. Consequently, analyses were made of ten lots of cream held at high temperatures, and ten at low. At the end of the holding period each lot was again divided into two equal parts of 10 pounds each. One of these sublots was neutralized, and the other was left untreated. Both sublots were pasteurized at 145° F. for twenty-five minutes in the shotgun pails provided with stirrers, and were then cooled to 50° F. After cooling,

papers were tied over the tops of the pails to prevent contamination as far as possible. Each sublot was either churned within two hours, or held until the following morning and then churned.

Bacteriological analyses were made on the cream before pasteurization, and on the neutralized and the unneutralized lots after pasteurization. The plating was generally done soon after the cooling process was begun. Whey agar was selected as the culture medium, because yeasts and molds grow well on it. The composition was as follows:

5 grams peptone
3 grams beef extract
15 grams agar
1000 cubic centimeters whey
0.2 per cent acidity

Two sets of plates were prepared. The plates in one set were incubated at 37° C. (98.6° F.), and those in the other at 28° C. (82.4° F.). Dilutions of 1 to 10,000, 1 to 100,000, and 1 to 1,000,000 were used for the fresh samples of cream, while on the older samples that were held, dilutions of 1 to 100,000, 1 to 1,000,000, and 1 to 10,000,000 were used. Dilutions of 1 to 100 and 1 to 1000 were used in plating all pasteurized samples. The plates were incubated for five days and were then counted.

The predominating types of colonies were inoculated into litmus milk, which was prepared according to a definite color standard — 1 cubic centimeter of litmus to 10 cubic centimeters of skimmilk. Check tubes were carried throughout. The bacteria were classified into the following groups according to their action on litmus milk: acid producers, peptonizers, inert types, alkali producers. The litmus tubes were incubated at the same temperature as the plates. Molds were noted but were not counted. Complete data could not be obtained on all ten lots of cream, because of accidents, but the averages for seven lots were obtained.

The results showed that there was practically no difference between the cream held at 70° to 75° F. and that held at 55° to 60° F. The acid producers predominated when the cream was fresh, and they still predominated in both lots of cream after it had been held.

Both lots of cream showed an increase in total count over the fresh samples, the cream held at the lower temperature showing the greater increase. Molds were found on a large number of the plates. Both the acid producers and the molds survived pasteurization. No yeasts were found on the plates, although at times the cream had a yeast-like odor.

No bacteriological examinations were made of the butter. In view of the literature previously cited, it was considered that bacteria do not grow to any appreciable extent in butter. The flavors that develop later are considered to be the result of changes which have taken place in the cream, and appear in the butter when conditions are favorable.

Neutralization of cream

It was deemed advisable to study to some extent the accuracy of neutralization. The possibility that titration with NaOH solution did not give the true acid value of the cream, or that $Ca(OH)_2$ and NaOH did not act similarly on the cream, was considered. In order to determine whether the action of these chemicals is similar, acid tests were run on

hirteen samples of very old cream. One sample was titrated with lime-vater of such a strength that 1 cubic centimeter would neutralize 0.0036 ram of lactic acid. A check sample was titrated with a NaOH solution, cubic centimeter of which would neutralize 0.00446 gram of lactic acid. ccurately weighed 10-gram samples were titrated, phenolphthalein being sed as indicator. The average acidity of the samples tested with lime-vater was 1.72 per cent, calculated as lactic acid, while the acidity of hose tested with NaOH was 1.71 per cent. This acidity is considerably igher than is normally produced by the usual lactic-acid types. Micro-copic examinations revealed the fact that *Bacterium Bulgaricum* pre-ominated in most of the samples. It is known that this organism pro-luces high acidity in cream.

With this information gained, it was assumed that NaOH gave prac-ically the same results in the reduction of acidity as does lime, and that he amount of lime needed could be computed accurately. Previous to his, the lime had been weighed out and mixed with water immediately efore each neutralization. This procedure required too much time to be racticable. It was decided to make a lime mixture and keep it in a glass ontainer for the remainder of the investigation. A 15-per-cent mixture by weight) of lime and water was prepared, the quantities used being 15 grams of lime to 85 grams of water. The lime was first slowly slaked with boiling water so as to drive off the carbon dioxide and prevent the formation of $CaCO_3$, which is very insoluble in water. The necessary quantity of water was added and the mixture was boiled for five minutes. This boiling seemed to break up any lumps that had remained. Boiled water was added to replace the water lost by evaporation. This solution was kept in a stoppered glass container as a stock mixture. An intimate mixture of lime and water was thus obtained, and after thorough shaking some time would elapse before the $Ca(OH)_2$ would settle. When some of this mixture was poured into the palm of the hand and allowed to run off, nothing remained on the hand but a milk-like mixture. This lime might have contained some magnesium. A tendency to neutralize beyond 0.25 per cent was found in the preceding experiment, so that the standard for this series was set at 0.30 per cent acid. The acid test of the cream was made by weighing out 50 grams of cream and titrating it with a tenth normal sodium hydrate solution, phenolphthalein being used as indicator. The number of cubic centimeters of alkali used was multiplied by the factor 0.018, which gave the percentage of acidity directly.

The amount of lime necessary to lower the acidity in the cream to 0.30 per cent was determined as in the preceding experiment. Before this mixture of lime and water, or milk of lime, was weighed out, the bottle containing it was thoroughly shaken twenty-five times. This was done in order to insure uniform results throughout the experiment; if it is not done, the first lot weighed out will be appreciably weaker than the remaining lots. The amount of mixture needed was accurately weighed out into a glass beaker, and an equivalent amount of water was added before pouring it into the cream. The cream was stirred continuously while the mixture was being slowly added. The extra water was added to dilute the mixture, because it had been found that when the concentrated mixture was added and the cream was not properly stirred, a large amount of curd would precipitate out of the cream during pasteurization. The

curd was very rubbery and had a lime-like taste. No analysis of it was made. Another reason for diluting the lime mixture was to do away with the danger of over-neutralization and of saponification of the milk fat, which might occur if the lime was too concentrated when brought into contact with the cream.

The neutralized and the unneutralized cream was pasteurized at 145° F. for twenty-five minutes and then cooled below 50° F. Both lots were churned either two hours afterward or the following morning. The acidity was determined just before churning.

The cream was churned in hand churns (Babcock No. 1) until the fat clusters were the size of pop-corn seed. The buttermilk was drawn off and the fat washed twice with water at 56° F., with one revolution of the churn in the first wash-water and ten in the second water.

Samples were taken before and after salting. These samples were well worked on a butter board, with a straight wooden ladle. After the working, the samples were double-wrapped in vegetable parchment paper and placed in a refrigerator at 50° F. The part to be salted was weighed out, and 4 per cent of salt (by weight) was added while the butter was in a granular condition. Some of this salt was lost in the working process, so that a little less than 3 per cent remained in the butter. The butter was scored the day following churning. On different occasions duplicate samples were judged, in order to test the judges and see whether they were consistent in their scores. The average number of judges was seven.

The acidity before pasteurization and before churning, and the average score of the butter both when fresh and after having been held in storage, are given in tables 3 and 4:

TABLE 3. EFFECT OF NEUTRALIZING THE ACIDITY OF CREAM, ON THE FLAVOR OF BUTTER

	Cream held at high temperature (70° to 75° F.)	Cream held at low temperature (50° to 55° F.)
Average fat content (per cent)	34.33	34.33
Average acidity before pasteurization (per cent)	0.76	0.69
Average acidity of untreated cream before churning (per cent)	0.73	0.65
Average drop in acidity due to pasteurization (per cent)	0.03	0.04
Average acidity of neutralized cream before churning (per cent)	0.28	0.28
Average score of unsalted butter made from neutralized cream	89.83	90.01
Average score of unsalted butter made from untreated cream	86.67	87.46
Difference of score in favor of neutralized sample	3.16	2.55
Average score of salted butter made from neutralized cream	88.86	89.49
Average score of salted butter made from untreated cream	86.35	87.25
Difference of score in favor of neutralized sample	2.51	2.24

Some investigators have considered that the curd content of butter made from pasteurized sour cream is higher than that of butter made from neutralized pasteurized cream. In order to see whether there was a difference, analyses were made of eight samples of these two types of butter. The samples taken were from butter made of the cream held at 50° to 55° F., and were unsalted.

TABLE 4. AVERAGE SCORES OF BUTTER KEPT IN STORAGE, MADE FROM NEUTRALIZED AND UNNEUTRALIZED CREAM HELD AT HIGH AND LOW TEMPERATURES, RESPECTIVELY

	Average score of butter made from cream held at high temperature (70° to 75° F.)	Average score of butter made from cream held at low temperature (50° to 55° F.)
Neutralized salted butter	81.86	82.00
Unneutralized salted butter	81.02	81.38
Difference in score in favor of neutralized sample	0.84	0.62
Neutralized unsalted butter	83.00	82.64
Unneutralized unsalted butter	81.94	82.78
Difference in score in favor of neutralized sample	1.06	.....

The acid value and the Reichert-Meissl number were determined on these samples at different intervals when the butter was fresh, and at the end of the third and the seventh week, respectively. The samples were scored at the time when these determinations were made.

In analyzing the butter, about 10 grams was accurately weighed into a dried, cooled, aluminum cup of known weight. The moisture was driven off over an open flame and the weight was recorded. The fat was extracted from the water-free butter by means of petroleum ether, and the residue was dried in a vacuum oven at 100° C. until the sample ceased to lose weight. The weight was then again recorded. The amount of curd was determined by difference. The curd content of butter consists of protein material and ash, insoluble in petroleum ether, and is composed largely of casein. It is known that casein gives an acid reaction or unites with an alkaline solution. Theoretically, then, some of this casein should unite with the lime during the process of neutralizing. This in turn should give a lower acid value in the neutralized-cream butter.

The acid value is the number of cubic centimeters of tenth normal NaOH required to neutralize one gram of butter, and was obtained by titrating, in boiling distilled water, from 10 to 20 grams of butter with tenth normal NaOH, phenolphthalein being used as indicator. A clear end-point could be obtained when the emulsion was kept nearly at the boiling temperature. A number of experiments were run, using different liquids as solvents, and water gave the closest results. The acid value remained fairly constant throughout the seven-weeks period, as is shown in table 5:

TABLE 5. AVERAGE ACID VALUE OF NEUTRALIZED- AND OF UNNEUTRALIZED-CREAM BUTTER*

	Age of sample		
	Fresh	3 weeks	7 weeks
Neutralized-cream butter	0.170	0.164	0.174
Unneutralized-cream butter	0.170	0.166	0.177

*Analyses made by W. V. Price.

The Reichert-Meissl number was determined according to the method devised by Leffman and Beam. It is seen from table 6 that the Reichert-Meissl number for neutralized and that for unneutralized-cream butter were practically the same.

TABLE 6. AVERAGE REICHERT-MEISSL NUMBER OF NEUTRALIZED- AND OF UNNEUTRALIZED-CREAM BUTTER *

	Age of sample		
	Fresh	3 weeks	7 weeks
Neutralized-cream butter	28.04	29.72	28.57
Unneutralized-cream butter	28.02	29.43	28.82

*Analyses made by W. V. Price.

The butter was scored by several judges, and the average was taken as the score of the butter. The average scores are given in table 7:

TABLE 7. AVERAGE SCORES OF NEUTRALIZED- AND OF UNNEUTRALIZED-CREAM BUTTER*

	Age of sample		
	Fresh	3 weeks	7 weeks
Neutralized-cream butter	89.70	85.07	83.62
Unneutralized-cream butter	86.00	83.10	82.30
Difference in score	3.70	1.97	1.32

*Analyses made by W. V. Price.

The acid value remained fairly constant throughout the seven-weeks period.

The neutralized-cream butter had a curd content of 0.88 per cent. This was slightly lower than that of the unneutralized-cream butter, which was 0.98 per cent. There seemed to be no particular relation between the curd content and the acid value.

The flavor seemed to be the only distinguishing characteristic between the two classes of butter. This difference in flavor was noticeable throughout the three scorings, but was less so as the butter became older. The neutralized-cream butter had a better flavor than the unneutralized, but its keeping qualities were not very good.

Since neither the Reichert-Meissl number, the acid value, nor the curd content furnished a means of differentiating between the two types of butter, no further tests were made. It was felt that if the Reichert-Meissl number showed no difference, it would be extremely doubtful whether the iodine-absorption number or the saponification number would show any.

OBSERVATIONS ON THE SCORE OF BUTTER WHEN FRESH

As already stated, the butter made from neutralized cream had a better flavor than that made from unneutralized cream. The average score of the neutralized unsalted butter was 89.92, while that of the unneutralized butter was 87.07. The probable errors of the scores were calculated for these two groups of butter, with the following results:

Neutralized unsalted butter	89.92±0.033
Unneutralized unsalted butter	87.07±0.283
Difference in score	2.85±0.285 [1]

Since the difference (2.85) is ten times the probable error (0.285), a significant difference exists between the neutralized and the unneutralized unsalted butter.

The salted butter made from the neutralized and the unneutralized cream was compared in the same manner, with the following results:

Neutralized salted butter	89.18±0.161
Unneutralized salted butter	86.80±0.241
Difference in score	2.38±0.289 [1]

In this comparison the square root of the sums of the squares of the probable errors is a little less than one-eighth of the difference between the average score of the neutralized and of the unneutralized salted butter. This indicates that a significant difference exists between these two classes of butter also.

The characteristic metallic flavor was not detected in the neutralized samples, although it was detected in three of the unneutralized. There was no fishy flavor in any of the fresh samples.

The salted samples of neutralized butter scored from half a point to one point lower than the unsalted samples. The difference between the salted and the unsalted samples was not so great in the unneutralized-cream butter as in the neutralized samples. This difference was not due to the butter being salty, but to the poor flavors present that were brought out by the salt.

OBSERVATIONS ON THE SCORE OF BUTTER HELD IN STORAGE

The butter was stored in a refrigerator the temperature of which varied from 50° to 55° F. It was held in storage from forty to eighty days and

[1] According to C. B. Davenport's *Statistical Methods*, the probable difference of $A_1 - A_2$ is $\sqrt{E_1^2 + E_2^2}$, in which A_1 and A_2 are averages and E_1 and E_2 are their respective probable errors:

$$89.92 - 87.07 \pm \sqrt{(0.033)^2 + (0.283)^2}$$
$$2.85 \pm \sqrt{0.001089 + 0.080089}$$
$$2.85 \pm \sqrt{0.0812}$$
$$2.85 \pm 0.2849, \text{ or } 0.285$$
$$2.85 \div 0.285 = 10$$
$$89.18 - 86.80 \pm \sqrt{(0.161)^2 + (0.241)^2}$$
$$2.38 \pm \sqrt{0.025921 + 0.058081}$$
$$2.38 \pm \sqrt{0.084}$$
$$2.38 \pm 0.2898$$
$$2.38 \div 0.2898 = 8.2$$

was then scored by six judges. Much of it had become moldy due to contamination from the refrigerator.

As shown in table 4 (page 11), both the salted and the unsalted butter made from the neutralized cream held at high temperature, scored higher than that made from unneutralized cream. The butter made from neutralized cream held at low temperature scored about the same as the butter made from the same cream but not neutralized. The keeping quality of the neutralized butter was not much better than that of the unneutralized. It is impossible to say what the relation would be in the quality of neutralized and unneutralized butter stored at lower temperature.

A study of table 3 (page 10) shows that the neutralization was fairly accurate, as the drop in acidity due to pasteurization plus the drop due to neutralization checks very closely with the standard of 0.30 per cent. The acidity of the cream held at high temperature checked within 0.01 per cent of 0.30 per cent, and that of the cream held at low temperature checked within 0.02 per cent.

According to the bacteriological study, no close relationship existed between bacteria count, types of bacteria, acidity of cream, and score of the butter. It would seem that the low score of the butter from the pasteurized, unneutralized cream was not caused by an excess of acid alone, but more probably was due to pasteurization of the cream in the presence of high acidity. In other words, the presence of a large amount of acid in cream when it is pasteurized may have a considerable influence on the score of the butter. It was to study this point that the investigation described in the following paragraphs was planned.

Influence of acid in cream on the butter churned from it

Thus far there had been no check on the pasteurized, unneutralized cream. Therefore it was impossible to tell what the score of the butter would have been if unpasteurized and unneutralized cream had been used. It was planned to churn one sample raw. Instead of dividing the original batch of cream into two lots, as was done previously, it was divided into four. One lot was churned raw and unneutralized, one was pasteurized and unneutralized, one was neutralized and pasteurized, and one was neutralized, pasteurized, and ripened. The object in ripening the neutralized cream in the fourth sample was to see whether the flavor of the neutralized butter was improved because of a lack of acid.

Commercial starter was used to inoculate the cream. A 10-per-cent inoculation, by weight, was made after the cream had been neutralized, pasteurized, and cooled to 70° F. The cream was allowed to stand for thirty minutes at this ripening temperature, and was then cooled to below 50° F. It was churned the next morning. With the exception of ripening the cream, as just noted, the methods of neutralizing, pasteurizing, and churning it, and the methods of washing, salting, and working the butter, were unchanged. Eight sets of churnings were made, or thirty-two in all. The butter was stored at a temperature of from 50° to 55° F. for from ten to twenty-seven days. It was planned to hold the samples for a longer period, but the results of the previous work, when the butter became covered with mold, discouraged such an attempt. The results of this work are shown in table 8. It is seen that the average score of the unsalted butter made

TABLE 8. APPARENT INFLUENCE OF ACID IN CREAM TREATED IN DIFFERENT WAYS, ON THE QUALITY OF THE BUTTER

	Raw cream	Unneutralized, pasteurized cream	Neutralized, pasteurized cream	Neutralized, pasteurized, ripened cream
Average fat content (per cent).....	32.56	32.56	32.56	32.56
Average acidity before pasteurization (per cent).....	0.60	0.60	0.60	0.60
Average acidity before churning (per cent).....	0.61	0.57	0.28	0.46
Average drop in acidity due to pasteurization (per cent).....	.....	0.03	.....	.....
Average score of unsalted butter....	86.2	86.7	88.8	87.6
Average score of salted butter.....	86.8	86.2	88.3	88.4

from neutralized, pasteurized cream was 2.6 points higher than that made from raw cream, 2.1 points higher than that made from unneutralized, pasteurized cream, and 1.2 points higher than that made from neutralized, pasteurized, ripened cream. The salted butter made from neutralized, pasteurized cream averaged 1.5 points higher than the raw-cream butter, 2.1 points higher than the butter from the unneutralized, pasteurized cream, and practically the same as that from the neutralized, pasteurized, ripened cream.

The addition of salt had a tendency to lower the score of the butter made from both the neutralized and the unneutralized cream, but it seemed to raise the score of the butter made from the raw cream and from the neutralized, pasteurized, ripened cream.

It is realized that the data submitted are too meager to warrant definite conclusions, but certain points regarding flavor are significant. The butter made from neutralized, pasteurized, ripened cream did not have any better flavor than that made from neutralized, pasteurized cream; while the butter made from raw, unneutralized cream did not have as good a flavor as that made from pasteurized cream.

It is interesting to note that again the drop in acidity due to pasteurization plus the drop due to neutralization checks closely with the 0.30 per cent to which the acidity was reduced.

The average score of each lot of butter, together with the number of days it was held in storage, is given in table 9 (page 16). The figures seem to show that, in the unsalted samples, the butter made from neutralized, pasteurized, ripened cream keeps the best, while in the salted samples the butter made from neutralized, pasteurized cream has the best keeping qualities. Most of the samples had deteriorated materially. Molds had grown on a number of them, and no doubt this condition did much to lower the score. There seemed to be no relation between the acidity to which the cream was neutralized, and the keeping quality of the butter.

TABLE 9. AVERAGE SCORE OF SAMPLES, AND AGE WHEN SCORED

	Sample								Average of series
	P 10 days	O 12 days	Z 17 days	X 25 days	W 27 days	Y 21 days	V 32 days	M 13 days	19.6 days
Unneutralized, pasteurized cream; butter unsalted	88.4	82.2	81.4	81.4	80.6	80.2	82.0	83.6	82.5
Unneutralized, raw cream; butter unsalted	84.8	81.0	84.0	80.6	79*	79*	80.2	80.0	81.1
Neutralized, pasteurized cream; butter unsalted	89.6	81.8	82.6	79*	80.4	79*	81.6	85.2	82.4
Neutralized, pasteurized, ripened cream; butter unsalted	86.4	84.6	80.0	83.0	81.8	82.6	81.0	81.2	82.6
Unneutralized, pasteurized cream; butter salted	84.6	81.8	83.6	80.6	81.4	82.6	79*	82.4	82.0
Unneutralized, raw cream; butter salted	85.6	82.2	81.4	82.6	79*	81.6	82.4	83.8	82.3
Neutralized, pasteurized cream; butter salted	84.4	87.2	84.0	82.6	83.6	82.4	79*	85.0	83.8
Neutralized, pasteurized, ripened cream; butter salted	83.8	85.4	81.0	85.6	85.2	84.4	79*	83.4	83.5

* Too low to score (below 80); given a value of 79.

SUMMARY

The data in the foregoing pages indicate that in this investigation the butter made from neutralized, pasteurized cream had a better flavor than that made from the same cream unneutralized, whether raw or pasteurized.

Salting, as a rule, did not improve the flavor of butter made from cream that had been neutralized. It had a tendency to bring out "off" flavors, and thus lower the score.

From the standpoint of flavor it did not seem advisable to ripen neutralized cream.

A high acid condition alone, or a high bacteria count, did not necessarily render cream unfit for neutralization.

In commercial plants it is difficult to neutralize to a definite standard, but this difficulty did not seem to arise in this investigation. It is true that in some individual samples there were exceptions, but the average results checked very closely with the standards set. It might be explained that the cream used in this investigation was not as high in acidity as the cream sometimes found in creameries in the centralizer territory, and further that often the cream used in these places has a much lower fat content. Moreover, the cream was accurately weighed on small scales and the exact weight was known, whereas in large creameries the weight may be estimated or measured in a vat. The lime used was supposed to have been calcium lime but might have contained some magnesium. This, of course, would make a stronger neutralizing agent. No analysis was made of the lime.

The butter made from the neutralized cream did not keep much better than that made from the unneutralized. This, no doubt, was due to relatively high storage temperatures. In the few unsalted samples that were scored at the end of three weeks, the neutralized lot showed better keeping qualities. It may be that if higher temperatures had been used in pasteurization, the results would have been different in this respect. Sproule and Grimes (1921) found that neutralized butter possessed good keeping qualities but that it did not keep any better than did unneutralized butter.[2] The butter with which they experimented was stored at 0° F., while the butter in this investigation was held at about 50° F.

The Reichert-Meissl number and the acid value did not furnish means of differentiating between neutralized- and unneutralized-cream butter.

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THE INHERITANCE OF A LETHAL PALE GREEN SEEDLING CHARACTER IN MAIZE

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THE INHERITANCE OF A LETHAL PALE GREEN SEEDLING CHARACTER IN MAIZE[1]

A. M. Brunson

In the genetic analysis of maize, an increasing interest is apparent in the inheritance of those factors which determine the production of chlorophyll. The number of such factors which have been proved to be genetically distinct approximates 50 per cent of the total number of factors at present being studied in corn investigations in the Department of Plant Breeding at Cornell University. The interest in the subject is due in part to the ease with which the resulting characters may be observed and followed, and in part to the relative frequency of mutations affecting chlorophyll development. In a systematic search for variations in varieties of corn grown in the Northern States, Hutchison (1922 a) observed 530 families throwing chlorophyll deficiencies, out of a total of 681 families which showed variations in the seedling stage. Altho in later tests many of these characters may be proved to be due to identical genes, a large number of phenotypically similar characters have been shown to be caused by factors which are genetically distinct, so that it seems certain that normal chlorophyll is due to no less than forty separate factors, and it is very likely that this number may be considerably greater.

PREVIOUS WORK

The first published account reporting lethal maize seedlings, of which the author is aware, is that of Halsted and Kelsey (1904), which includes a photograph showing albino seedlings, and presents counts. The authors of that publication were unable to significantly modify the ratios by various treatments of seeds and plantlets, and they concluded that "the results point toward close fertilization as the cause of the phenomenon." Gernert (1912) later suggested a Mendelian interpretation of these results, and reported additional data from selfed ears of his own cultures which threw approximately one albino to three green seedlings. At about the same time, Emerson (1912), in reporting a group of chlorophyll abnormalities, described two lethal seedlings, one a pure albino and the other yellowish white at first but later becoming yellowish green and finally "a fairly strong green." He also presented evidence to show that these characters behave as simple Mendelian recessives.

[1] Paper No. 110, Department of Plant Breeding, Cornell University, Ithaca, New York.

SOURCE AND DESCRIPTION OF MATERIAL

The pale green seedling reported in this paper was first observed in the autumn of 1920 in greenhouse cultures planted from Illinois acquisition ear 33. This seed was from a selfed ear from pedigree 809 of the Illinois High Yield strain grown by the Illinois Agricultural Experiment Station. There was a sharp distinction between the normal green and the pale green seedlings, the leaves of the latter being of a pale greenish yellow color. In greenhouse cultures grown during December, the color of the pale green seedlings sixteen days after planting corresponded closely with "Bright Chalcedony Yellow" XVII 25′ in Ridgway's *Color Standards* (1912), whereas the normal greens of the same family most nearly resembled "Light Bice Green" XVII 29′.

CHLOROPHYLL CONTENT

An approximation of the relative amounts of chlorophyll and yellow pigments in the normal and the pale green seedlings was made by a method similar to that mentioned by Correns (1903). Equal weights of leaves from both types were extracted with alcohol, and the extract was separated into green and yellow components by means of washing with petroleum ether. By diluting the extracts from the normal leaves until they were equal colorimetrically to the extracts from the pale green seedlings, it was ascertained that the latter contained approximately 15 per cent as much chlorophyll and 50 per cent as much xanthophyll and carotin as did the normal green seedlings. These pale green seedlings have so far always proved to be lethal, both when planted in the greenhouse during the autumn and winter, and when grown under field conditions in the summer. Altho distinguishable from the first emergence of the leaves, the contrast between the pale green and the normal seedlings becomes more pronounced with the increasing age of the plants. The best time to make the separations under greenhouse conditions is from fifteen to twenty days after the time of planting. Shortly afterward the leaves of the pale green seedlings begin to assume a water-soaked appearance and the plants gradually wither and die. The fact that the leaves become lighter and lighter suggests that possibly the deficiency of chlorophyll may be due to a rate of chlorophyll production slower than the rate of its destruction when the plants are exposed to normal sunlight, rather than to an entire absence of the ability to synthesize normal chlorophyll in the later stages. Preliminary tests under partial shade indicate that the plants so grown are darker green in color and live longer than when grown in the open. Further and more carefully controlled experimentation with respect to this behavior is contemplated.

INHERITANCE

A simple Mendelian recessive

All data so far accumulated indicate that this pale green seedling character is inherited as a simple Mendelian recessive and differs genetically from the normal type in a single pair of factors. The deviations shown in table 1 are so small in comparison with the probable errors, in all cases,

TABLE 1. Seedling Counts Showing Segregation of Green and Pale Green Seedlings

Pedigree no.	Number of ears	Observed		Calculated 3:1		Deviation*	Dev. / P. E.
		Green	Pale green	Green	Pale green		
Ill. Acq. 33.....	1	38	11	37	12	1.0± 2.04	0.5
314.....	1	142	38	135	45	7.0± 3.92	1.8
317.....	1	146	58	153	51	7.0± 4.17	1.7
319.....	1	129	45	130	43	1.5± 3.85	0.4
653.....	7	1,644	538	1,636	545	7.5±13.64	0.5
661.....	7	1,170	390	1,170	390	0.0±11.54	0.0
Total.....	18	3,269	1,080	3,262	1,087	7.0±19.26	0.4

*Probable errors of Mendelian frequencies are calculated from the formula P.E. = $\pm 0.6745\sqrt{p \times q \times n}$, in which p and q are the expected proportions expressed in percentages, and n is the total number of individuals involved.

that it is a practical certainty that the inheritance is Mendelian and that not more than one pair of factors is involved in the crosses thus far studied. In order to distinguish this pair of factors from other pale green factors known but not as yet reported, it is proposed to designate it by the symbols Pg_1 pg_1.

Relation to aleurone factors

Acquisition ear 33 was planted in the plant-breeding garden at Cornell University in 1921 and designated as pedigree 91. The relationship and factorial composition of families related to this foundation ear and referred to in this paper, are shown in table 2:

TABLE 2. RELATIONSHIPS OF PEDIGREES RELATED TO FOUNDATION EAR

Illinois High Yield 809 selfed		—> Illinois Acquisition Ear 33 planted as Pedigree 91		
A A c c r^r r^r Sh Sh D D Su Su Li$_1$ Li$_1$ Pg$_1$ pg$_1$				
91– 1	×	*a a C C R R Pg$_1$ Pg$_1$* E11603–7	—> 314, 649	
– 6	×	*A A C C R^g R^g sh sh Su su Pg$_1$ Pg$_1$* H819–7	—> 315, 653	
– 9	×	*A A C C R R Pg$_1$ Pg$_1$* H821–4	—> 316, 657	
–11	×	*A A C C R R d d Pg$_1$ Pg$_1$* H899–21	—> 660	
–12	×	*A A C C R R d d Pg$_1$ Pg$_1$* H899–16	—> 317, 661	
–14	×	*li$_1$ li$_1$ Pg$_1$ Pg$_1$* H806–4	—> 318 selfed —>	668, 669, 670, 671, 672, 673, 721, 722
–16	×	*a a C C R R Pg$_1$ Pg$_1$* G153–9	—> 319, 664	

The crosses listed in table 3 were made with aleurone testers of known factorial composition in order to determine the aleurone constitution

TABLE 3. TESTS OF PEDIGREE 91 FOR ALEURONE CONSTITUTION

Cross no.	Constitution of tester	Resulting ear
91– 1 × E11603– 7	*a a C C R R i i*	All colored aleurone
–16 × G153– 9	*a a C C R R i i*	All colored aleurone
–12 × G154– 6	*A A c c R R i i*	All colorless aleurone
–13 × G203–10	*A A C C r r i i*	All colorless aleurone

of this pedigree. From this table it is seen that for four of the five pairs of factors affecting aleurone color (Emerson, 1918), family 91 must be of the constitution *A A c c r r i i*. All of the plants of family 91 were dilute sun red, confirming the presence of *A A*. Subsequent segregation of aleurone color in crosses of family 91 with *A*-testers and plants with homozygous colored aleurone gave ratios expected from this constitution, as shown in table 4:

TABLE 4. Segregation of Seeds for Aleurone Color

Parentage	Pedigree no.	Number of ears	Number of F_2 seeds	
			Colored	Colorless
91 × *a a C C R R*	314	2	199	239
	319	4	314	479
	649	2	99	135
	664	6	1,350	1,840
Total observed			1,962	2,693
Calculated 27:37			1,964	2,691
Deviation			2.0±22.7	
91 × *A A C C R R*	315	2	201	135
	316	1	54	51
	317	2	207	143
	653	7	1,391	1,127
	660	3	432	374
	661	7	985	687
Total observed			3,270	2,517
Calculated 9:7			3,255	2,532
Deviation			15.0±25.5	

F_1 pedigrees 314, 315, 316, 317, and 319 were grown to maturity in the greenhouse during the winter of 1921–22. In the following spring, when the seed thus produced was separated on the basis of aleurone color and planted, it was observed that there was a deficiency of pale green seedlings from the seed with colored aleurone and an excess of pale greens from the seed with colorless aleurone, indicating the possibility of a linkage between either *C* or *R* and the factor for pale green. As the numbers of seedlings were small, several more ears of F_1 plants were selfed in the field during the summer of 1922. Detailed counts showing the segregation of selfed ears from families 653 and 661 for several characters, which are summarized in later tables, are given in tables 5 and 6, respectively.

TABLE 5. F_2 SEEDLING COUNTS OF SELFED EARS FROM PEDIGREE 653

Pedigree no.	Colored aleurone												Colorless aleurone												Total
	Starchy non-shrunken				Starchy shrunken				Sugary				Starchy non-shrunken				Starchy shrunken				Sugary				
	Red		Non-red		Red		Non-red		Red		Non-red		Red		Non-red		Red		Non-red		Red		Non-red		
	Green	Pale green	Green	Pale green	Green	Pale green	Green	Pale green	Green	Pale green	Green	Pale green	Green	Pale green	Green	Pale green	Green	Pale green	Green	Pale green	Green	Pale green	Green	Pale green	
653– 1....	81	25	8	2	31	6	10	1	12	4	5	0	58	30	1	1	10	10	0	0	12	10	5	0	322
– 4....	66	16	30	4	23	5	10	0	10	2	5	1	44	43	13	0	5	5	1	0	12	7	8	4	314
– 7....	70	11	27	1	33	2	16	0	13	3	10	1	58	45	20	1	6	3	1	0	13	12	5	0	351
–10....	62	17	16	0	25	10	10	0	12	5	8	1	66	41	17	1	9	8	0	0	18	11	9	2	348
–12....	44	12	27	0	20	6	9	0	9	2	14	0	41	21	9	1	3	7	0	0	7	2	4	0	238
–13....	28	1	10	0	14	0	7	0	3	4	11	1	35	16	9	1	2	7	0	0	5	5	6	0	165
–14....	112	17	46	4	30	7	32	1	..	..	..	..	85	59	24	3	12	9	2	1	..	..	..	..	444
Total.....	463	99	164	11	176	36	94	2	59	20	53	4	387	255	93	8	47	49	4	1	67	47	37	6	2,182

TABLE 6. F_2 Seedling Counts of Selfed Ears from Pedigree 661

Pedigree no.	Colored aleurone				Colorless aleurone				Total
	Tall		Dwarf		Tall		Dwarf		
	Green	Pale green	Green	Pale green	Green	Pale green	Green	Pale green	
661– 1	56	6	32	3	30	9	7	5	148
– 5	45	6	16	3	20	17	9	8	124
– 7	136	20	52	4	80	48	40	21	401
– 9	87	20	29	5	26	39	15	11	232
–10	110	10	31	7	33	33	15	13	252
–11	103	9	32	6	45	35	21	17	268
–14	51	5	24	3	21	19	4	8	135
Total	588	76	216	31	255	200	111	83	1,560

A summary of all the seedling tests grown from those selfed ears having a 9:7 aleurone ratio and also throwing pale green seedlings is given in table 7:

TABLE 7. Segregation of Pale Green Seedlings from Colored and Colorless Seeds

Pedigree no.	Number of ears	Colored aleurone		Colorless aleurone		Total
		Green	Pale green	Green	Pale green	
317	1	94	21	52	37	204
653	7	1,009	172	635	366	2,182
661	7	804	107	366	283	1,560
Total observed		1,907	300	1,053	686	3,946
Calculated 27:9:21:7		1,665	555	1,295	432	3,947
Deviation		+242	—255	—242	+254	—1

* $\chi^2 = 346.9016$ P = 0.000000

* Goodness of fit of ratios involving more than two classes are calculated by the method suggested by Weldon (1901-02) and elaborated by Harris (1912).

The probability is too small to leave any reasonable doubt that the deviations may be due to random errors from the ratios expected with independent inheritance; moreover, the deviations are all consistently

in the same direction, confirming the first indication of a coupling series between Pg_1 and either C or R. Since the pale green plants always die in the seedling stage, it is obviously impossible to grow homozygous recessives with which to make backcrosses, so that any calculations of linkage intensities must necessarily be made from counts of F_2 populations. It would require at least two generations more to cross homozygous purple aleurone strains throwing pale greens, which have now been isolated, with C-testers and R-testers to determine directly the linkage relations; consequently an indirect determination, both of the percentage of crossing-over and of the factor concerned, is here presented.

Calculation of percentage of crossing-over

A modification of Emerson's formula (1916) for calculating linkage intensities from a di-hybrid F_2 population was determined for a tri-hybrid F_2 population involving two complementary factors, one of which is linked with a third factor. In this case the two complementary factors are C and R, and the third factor which is linked with one of the first two is pg_1. If r:s:s:r represents any gametic series between the two linked factors, the four phenotypic classes may be represented by the following equations:

$AB = 9r^2 + 12rs + 6s^2$	Colored aleurone, normal green seedling
$Ab = 6rs + 3s^2$	Colored aleurone, pale green seedling
$aB = 3r^2 + 12rs + 6s^2$	Colorless aleurone, normal green seedling
$ab = 4r^2 + 2rs + s^2$	Colorless aleurone, pale green seedling

These equations hold equally well for a coupling or repulsion series or for independent inheritance, the difference being that in a coupling series $r > s$, in a repulsion series $r < s$, and in independent inheritance $r = s$. In the last-mentioned case the phenotypic classes are in the expected proportion of 27:9:21:7. From these equations it follows that

$$18r^2 = AB + 3ab - (Ab + aB),$$

then

$$r = \sqrt{\frac{AB + 3ab - (Ab + aB)}{18}}; \qquad (1)$$

also

$$16(r^2 + 2rs + s^2) = AB + Ab + aB + ab,$$

and

$$4(r + s) = \sqrt{AB + Ab + aB + ab},$$

then

$$s = \tfrac{1}{4}\sqrt{AB + Ab + aB + ab} - r. \qquad (2)$$

As pointed out by Emerson (1916), calculations from such formulae give only approximations of the correct value for crossing-over where the ratios for each character taken individually deviate markedly from the expected. The ratio for total colored to colorless aleurone in table 7, however, is 2207:1739, or a deviation of 13.0 ± 21.0 from the expected 9:7 ratio; while the ratio for green to pale green seedlings is 2960:986, or a deviation of only 0.5 ± 18.3 from the expected 3:1 ratio. These deviations are so small in comparison with the probable errors that the formulae may be used with considerable accuracy.

Applying formulae (1) and (2) to the observed F_2 frequencies in table 7, and calculating the percentage of crossing-over in a coupling series from the formula

$$\text{per cent of crossing-over} = \frac{s}{r + s} \times 100,$$

the values given in table 8 are obtained:

TABLE 8. Gametic Ratios and Percentage of Crossing-over

Pedigree no.	r	s	Per cent of crossing-over
317	2.708	0.863	24.2
653	8.498	3.180	27.2
661	8.097	1.777	18.0
Total	12.0462	3.6581	23.3

Substituting the calculated values of r and s in the original equations presented to represent the four phenotypic classes, a very close fit to the observed results is obtained, as is seen from table 9:

TABLE 9. Comparison of Observed with Calculated Frequencies on Basis of Linkage

	Colored aleurone		Colorless aleurone		Total
	Green	Pale green	Green	Pale green	
Observed	1,907	300	1,053	686	3,946
Calculated 23.3 per cent crossing-over	1,915	305	1,044	682	3,946
Deviation	−8	−5	+9	+4	0
$\chi^2 = 0.2165$			P = more than 0.80125		

Elderton's tables (Pearson, 1914) do not give values for P where χ^2 is less than one, but it is manifest that this value must be very high, which confirms the hypothesis that the factor for pale green is linked with one of two aleurone factors.

Linkage tests with sh

The fact having been established that a linkage relation exists with either C or R, it remains to be proved which is the one concerned. If it is the C factor, one should expect approximately the same degree of association of the factor for pale green seedling with the factor pair *Sh sh* for filled and shrunken endosperm, since Hutchison (1922 b) has shown that there is only about four per cent of crossing-over between C and *sh*. Family 653 was heterozygous for the shrunken factor, and data of separations made on this basis are presented in table 10:

TABLE 10. Segregation of Pale Green Seedlings from Non-Shrunken and Shrunken Seeds, Pedigree 653

	Non-shrunken seeds		Shrunken seeds		Total
	Green	Pale green	Green	Pale green	
Observed	1,107	373	321	88	1,889
Calculated 9:3:3:1	1,063	354	354	118	1,889
Deviation	+44	+19	−33	−30	0
$\chi^2 = 13.5444$			P = 0.00369		

While the deviations from the expected are rather large, they are due in great measure to the poor germination of the shrunken seeds. The two classes from the non-shrunken seeds both show an excess over the expected, and the two classes from the shrunken seeds both show a deficiency, there being no piling-up in the two middle classes representing the parental types as would be expected if an association of factors existed. If the plants from each class of seed are considered separately, there is seen a ratio of 1107 green to 373 pale green from the non-shrunken seeds, which is a deviation of only 3.0 ± 11.2 from the expected, and a ratio of 321 green to 88 pale green from the shrunken seeds, which is a deviation of 14.0 ± 5.9. These data indicate independent inheritance between the factors pg_1 and *sh*, and consequently between pg_1 and C. Therefore, since pg_1 is linked with either C or R, the aleurone factor involved must be R.

Linkage tests with R

Fortunately there is confirmatory evidence of this relation from tests involving certain plant-color types. Emerson (1921 a) has shown that, when homozygous, certain factors designated as R^g and r^g of the allelomorphic R series inhibit the expression of red in dilute sun-red plants, causing them to be green. Since the parents of family 653 were $A\ A\ r^r\ r^r\ Pg_1\ pg_1 \times A\ A\ R^g\ R^g\ Pg_1\ Pg_1$, one would expect the F_2 seedlings to show approximately 75 per cent of the plantlets with reddish stems (designated in the tables as "red") and 25 per cent without red pigment (designated in the tables as "non-red"). From table 11 it is seen that there was a marked deficiency in the number of non-reds observed, there having been 1705 reds to 477 non-reds, or a deviation of 68.0 ± 13.6 from the expected 3:1 ratio. This deficiency of non-red plants was undoubtedly due to the fact that, owing to the inexperience of the author in making such separations, every plant which showed the least discernible trace of pink was classed with the reds.

TABLE 11. Segregation of Pale Green Seedlings in Relation to Plant Color, Pedigree 653

	Red = $r^r r^r + 2r^r R^g$		Non-red = $R^g = R^g$		Total
	Green	Pale green	Green	Pale green	
Observed	1,199	506	445	32	2,182
Calculated, independent inheritance	1,227	409	409	136	2,181
Deviation	−28	+97	+36	−104	+1
$\chi^2 = 106.3420$			P = 0.00000		
Observed	1,199	506	445	32	2,182
Calculated, 27.2 per cent crossing-over	1,132	505	505	40	2,182
Deviation	+67	+1	−60	−8	0
$\chi^2 = 12.6962$			P = 0.00547		

In spite of this deficiency of non-reds, it is evident in table 11 that when the observed numbers are compared with the expected frequencies calculated on a 9:3:3:1 basis, there is a distinct piling-up in the middle two parental classes. This fact clearly indicates associative inheritance. In table 8 the per cent of crossing-over in this family, based on aleurone color, is shown to be 27.2. If the expectancies of a repulsion series for

this intensity of linkage are calculated, it is seen, in the lower half of table 11, that a considerably better fit to the observed frequencies is obtained than on the assumption of independent inheritance, altho of course a good fit would not be expected because of the deficiency in the two classes involving non-reds. We may be certain, however, that all the seedlings in the non-red groups are correctly classified. Considering these two classes only, it may be seen in the following comparison how closely the observed numbers fit the calculated expectancies on the basis of 27.2 per cent crossing-over between R and pg_1:

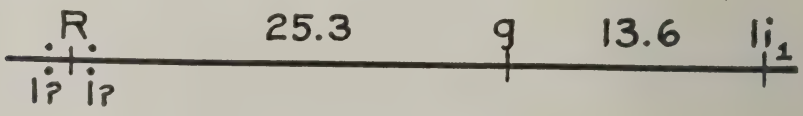
	Observed	Calculated, 3 : 1	Dev.	P. E.	Calculated, 27.2 per cent crossing-over	Dev.	P. E.*
Green	445	358	87	6.38	442	3	3.86
Pale green	32	119			35		
Total	477	477			477		

* P.E. $= 0.6745 \sqrt{0.92581 \times 0.07419 \times 477} = 3.86$, since the phenotypic ratio expected under this assumption is 92.581 : 7.419.

The evidence showing independent inheritance with *sh*, and strong indications of linkage with R based on observations of plant color, taken collectively, would seem to place pg_1 rather conclusively in the R group.

The order of the genes

The first case of linkage in the R group was reported by Lindstrom (1917) between R and g. The indications of linkage between g and a third factor l, mentioned in that paper, have since been substantiated (Lindstrom, 1918), and unpublished data show about 13 per cent of crossing-over between g and li_1, one of the factors for lineate leaves, the order being $R - g - li_1$. If the map distances of these factors are calculated by the use of Haldane's tables (Haldane, 1919), a chromosome map is obtained for this group as follows:



Altho there is as yet no certainty from actual trial that Haldane's tables, which were based upon observations of crossing-over in the first chromo-

some of *Drosophila melanogaster*, will prove equally applicable to maize, there is good reason to believe that they will be fairly accurate. Most certainly, "map distances" so calculated would be a better basis for prediction by addition and subtraction than would the raw percentages of crossing-over.

Data thus far presented show that pg_1 gives 23.3 per cent of crossing-over with *R*, which is equivalent to a map distance of 25.7. A three-point test involving *R*, *g*, and pg_1 is now under way to establish definitely the order of the genes. The only evidence available at present bearing on this point is an F_2 of a repulsion series between pale green and lineate. Since lineate is a mature-plant character and does not become evident until a considerable time after all the pale green seedlings have died, it is necessary to draw conclusions entirely from the distortion in the ratios of the mature-plant character caused by its linkage with the lethal seedling. For instance, in a repulsion series, one would expect ratios of 2:1 and 3:1 normals to lineates as the limits representing 0 per cent and 50 per cent of crossing-over, respectively. If pg_1 is at a map distance of 25.7 from *R*, it must be at a map distance of either 13.2 or 64.6 from li_1, which would be equivalent to about 12.6 per cent or 44.6 per cent of crossing-over, respectively.

TABLE 12. Segregation of Lineate Plants

Pedigree no.	Non-lineate	Lineate	Total
668	18	6	24
669	14	4	18
670	5	1	6
671	2	1	3
672	46	17	63
673	5	0	5
721	60	17	77
722	44	25	69
Total observed	194	71	265
Calculated, 44.6 per cent crossing-over	194	71	265
Deviation		0.0 ± 4.86*	
Calculated, 12.6 per cent crossing-over	178	87	265
Deviation		16.0 ± 5.16†	

* P.E. $= \pm 0.6745 \sqrt{0.733 \times 0.267 \times 265} = \pm 4.86$, since the phenotypic ratio expected under this assumption is 733:267.

† P.E. $= \pm 0.6745 \sqrt{0.672 \times 0.328 \times 265} = \pm 5.16$, since the phenotypic ratio expected under this assumption is 672:328.

From table 12 it is seen that the observed frequencies of lineate to non-lineate plants in F_2 pedigrees throwing pale green seedlings are in exactly the ratio expected on the assumption of 44.6 per cent crossing-over. The chances against the alternative possibility (that is, assuming 12.6 per cent crossing-over, where $\frac{\text{Dev.}}{\text{P. E.}} = 3.1$) are 26 to 1.

Altho these data are too meager to permit of positive conclusions being drawn from them, they indicate that the order of the genes may be $pg_1 - R - g - li_1$.

Linkage tests with other factors

If the order indicated in the preceding section proves to be correct, it will increase the known length of the chromosome considerably and may serve as a means of definitely fixing the position of some of the lone factors that have so long defied all attempts at grouping. The only one of these with which pg_1 has been tested is *d*, the factor for dwarf plants. From table 13 it is clear that there are no positive indications of linkage between pg_1 and *d*.

TABLE 13. SEGREGATION OF PALE GREEN SEEDLINGS IN RELATION TO DWARFS, PEDIGREE 661

	Tall		Dwarf		Total
	Green	Pale green	Green	Pale green	
Observed	843	276	327	114	1,560
Calculated	877	292	292	97	1,558
Deviation	−34	−16	+35	+17	+2
$\chi^2 = 9.3694$		P = 0.02533			

If the above-mentioned order of the genes is proved to be correct, it will be necessary to test pg_1 with those established linkage groups where proof does not already exist, by association of endosperm characters in anomalous seeds (Emerson, 1921 b), that *R* is situated in a separate chromosome. It is easily possible that two of the known groups may occupy opposite ends of the same chromosome but be too far apart to show linkage until some intermediate factor is discovered to bridge the gap. Those groups whose end factors should be tested with pg_1 are the $lg - B - te$ group (Emerson, 1920) and the $P - ts - br$ group (Emerson, 1920, and Kempton, 1921).

DISCUSSION

Aside from its being a step in the genetic analysis of corn, the study of pale green seedlings may be of interest from two other angles.

The first of these is from the practical, or farmer's, standpoint when this seedling is considered as one of a large number of weaklings, and more specifically as one of a group of lethal seedlings. From Hutchison's (1922 a) survey of a large number of commercial varieties, it seems probable that the presence of the various chlorophyll and morphological abnormalities in a heterozygous condition is much more frequent than is ordinarily supposed. What effect, if any, these recessive lethal factors when in a heterozygous condition may have on the general vigor and yield of corn plants is problematical; but if plants heterozygous for these factors are numerous, they will produce a considerable number of seeds homozygous for the lethal factor and in this way affect the stand of the following crop. The influence of small variations in stand on yield is not considered as important as formerly, however, since it has been shown that in a large measure the increased vigor of the surrounding plants compensates for an occasional missing plant. From purely theoretical grounds it can be shown that the proportionate number of plants carrying a lethal character in a population will become less with each succeeding generation, and will gradually approach complete extinction. The frequent appearance of such lethals in selfed ears of commercial strains would indicate that new mutations occur frequently enough to balance this breeding-out process.

The other possible interest in the study of pale green seedlings which occurs to the writer is shared by other examples of chlorophyll deficiency. As Professor Morgan aptly expresses it, " Experimental biology and general physiology are one and the same science," both attempting to explain the mechanism of life on a physico-chemical basis. Genetics is the branch which attempts to explain the transfer of causal factors from one generation to another, while physiology, as at present delimited, is chiefly concerned with the development and activities of the individual arising from a given factorial composition. As the genetic analysis of certain species becomes more and more complete, it would seem to offer a rare opportunity to tie up these two closely related fields of knowledge by an intensive physiological and biochemical study of those characters which have been worked out genetically, in the attempt to throw some further light on the constitution of the " gene " and the mechanism of its influence on the development of the fertilized egg into a mature individual of given characteristics.

SUMMARY

A new seedling character in maize, pale green, is described in this memoir. So far as observed, the pale green plants always die in the seedling stage.

The character is shown to segregate as a simple Mendelian recessive, and the symbols Pg_1 pg_1 have been assigned to the factor pair involved.

In crosses involving colored aleurone, the factor pg_1 is shown to be linked with either C or R.

Formulae are developed for calculating linkage intensities from F_2 populations involving complementary factors, one of which is linked with a third factor. Substituting observed frequencies in these formulae, an average value of 23.3 per cent of crossing-over is obtained.

Evidence from crosses involving the factors for shrunken endosperm and for inhibition of red stems in the seedlings show conclusively that the aleurone factor linked with pg_1 is R.

The few data now available seem to indicate that the order of the genes is $pg_1 - R - g - li_1$ which, if substantiated, will materially increase the known length of this chromosome.

ACKNOWLEDGMENT

It is a pleasure to the author to acknowledge his indebtedness to Dr. R. A. Emerson, who generously shared his material and was a constant source of help and inspiration.

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NORMAL AND PALE GREEN MAIZE SEEDLINGS FROM A SELFED EAR OF PEDIGREE 664

The photographs were taken 10 days (top row), 16 days (middle row), and 24 days (bottom row), after planting. Individuals 1, 5, and 8 from the left are lethal pale green seedlings

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MARCH, 1924 MEMOIR 73

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AGRICULTURAL EXPERIMENT STATION

CROWN-GALL OF APPLE AND PEACH WITH NOTES ON THE BIOLOGY OF BACTERIUM TUMEFACIENS

DONALD REDDICK and V. B. STEWART

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CROWN-GALL OF APPLE AND PEACH WITH NOTES ON THE BIOLOGY OF BACTERIUM TUMEFACIENS

DONALD REDDICK AND V. B. STEWART

THE CROWN-GALL DISEASE

The crown-gall disease, caused by *Bacterium tumefaciens* Smith & Townsend,[1] occurs on a great variety of plants and over a wide geographical range. It has been noted particularly in fruit culture from practically every fruit district in the United States, and the very general opinion expressed in the literature on this subject is that the disease is a dangerous one and its introduction into a planting is greatly to be feared.

The evidence bearing on the economic importance of the disease is largely observational and few experimental data are at hand to show its exact importance. The observational data are fully summarized by Smith, Brown, and Townsend[2] and need not be repeated here. In general, it may be concluded from these authors' digest of the literature that apples are not seriously affected but that peaches and many other plants are. These writers are inclined, however, to include apples (page 197 of the bulletin cited) in the list of plants that should be inspected for crown-gall, and to recommend rejection of trees showing galls or hairy root. They suggest that even if apple trees are not materially affected by crown-gall, the distribution of trees bearing galls will serve to spread the disease to new localities and to other hosts which are more susceptible and which may be injured thereby. Neither point seems to be well taken when one considers (1) the very wide distribution of the disease at the present time, and (2) that the apple constitutes a relatively permanent crop which is not interplanted except for a few years and then preferably with cultivated crops such as potatoes, beans, corn, and the like, that is, plants which do not develop the disease under natural conditions.

In a more recent publication, Erwin F. Smith[3] states that "when death results it is not due to the direct action of the bacteria, but to

[1] Attention is called to the fact that this organism is named *Bacterium tumefaciens* in conformity with the nomenclature of Erwin Smith, which is in common use among plant pathologists. According to the nomenclature commonly followed by bacteriologists, however (see *Bergey's Manual of Determinative Bacteriology*, 1923), this organism would be called *Phytomonas tumefaciens*.

[2] Smith, Erwin F., Brown, Nellie A., and Townsend, C. O. Crown-gall of plants: its cause and remedy. U. S. Dept. Agr., Bur. Plant Ind. Bul. 213:1–215. 1911.

[3] Smith, Erwin F. Further evidence that crown gall of plants is cancer. Science 43:871–889. 1916. (The quotation cited is on page 876.)

other factors, *e.g.*, nutritional defects, and secondary parasitisms," and it is to be expected, therefore, that climatic conditions, soil conditions, and various other factors may enter to cause even greater variations in different regions than would result if only the one complication were involved. For this reason, regional tests must be made to determine the destructiveness of the disease for any particular set of conditions.

In this connection it is to be recalled that some years ago F. C. Stewart [4] stated before a convention of fruit growers that "in New York, at least, apple crown gall is an unimportant disease." Stewart cites the C. H. Stuart orchard at Newark, New York, as an example. It has been objected that C. H. Stuart was engaged in the nursery business at the time when the orchard was set (the inference being that he was therefore not disinterested), and that apparently no healthy trees were set for comparison. The former fact practically assures that the trees really had crown-gall disease, and the latter is a natural mistake sometimes made by others than merely practical men.

The controversy concerning the number of trees originally set in the Stuart orchard, and particularly the question as to whether one hundred of the original trees died, possibly from crown-gall, led one of the writers (R) to visit the orchard. The following facts were either ascertained from E. V. Pierson (the present owner and a son-in-law of C. H. Stuart), or determined by personal observation. The orchard is one and a half miles directly north of Newark on Main Street. It is on the right-hand side and a little back from the road, and is permanently marked by a large stone some three feet in diameter which lies at the southwest corner. The exact limitations of the original planting of galled trees cannot be determined. There are more than a thousand trees in the orchard, all apparently of the same age and of the same general appearance. The block, therefore, constitutes a satisfactory experiment, because at least as many gall-free trees were used as trees bearing galls. The number of galled trees planted originally is of little consequence, but Mr. Stuart's statement to F. C. Stewart may be accepted as the more likely number, namely, 500 trees. The galled trees in particular constitute a mixed lot of varieties. Baldwin, Greening, Sutton, and Ben Davis were recognized, and others are present. The remainder of the orchard seems to be somewhat mixed, also. The experiment indicates that, to date, crown-gall has done no material damage. Allowing for the numerous varieties set indiscriminately, the orchard is pronounced "average" by W. H. Chandler, Professor of Pomology at Cornell University. Trees have died here and there and have been replaced. Excepting for a wet area which scarcely could have been included in the block of galled trees, the number of missing trees is not greater in one area than in another.

[4] Stewart, F. C. Interesting facts about crown gall of apple and peach. West. New York Hort. Soc. Proc. 53:97–98. 1908.

Recently, experimental data have been published on crown-gall experiments with apples, from the States of Iowa[5] and Montana.[6] The experiments were planned and executed on a large scale. In Montana it appears that while there was no noticeable effect on the vigor of the trees, nevertheless the root development of galled trees was not good, and it is thought that this would have become apparent when the trees began to bear heavy crops. In Iowa numerous growth data were recorded, and these show without exception that galled trees did not grow so fast as did trees free from gall. It should be noted, in this connection, that the method employed was one which has not yet received general indorsement by horticulturists.

An objection to all the experiments reported, including the one about to be recorded, is that the real test comes only with the production of fruit (because the trees are grown for the fruit they bear, not for the wood they produce). A well-planned experiment to determine the effect of crown-gall should extend well into or through the life of the plant. This would be a very long time for apple trees, but could be done relatively easily with peaches.

A proper interpretation of any of the crown-gall experiments thus far reported is rendered difficult by the fact that the experimental trees used have consisted of a miscellaneous collection for which there are no data as to original source, particularly as to the exact character and origin of the stock on which the trees were grown. The Iowa experiments illustrate this very well. One of the conclusions of Greene and Melhus is that Wealthy is more susceptible to crown-gall than is Jonathan. It is difficult to understand how this can be, since the varieties were grafted on seedling stock and an examination of the illustrations indicates that the galls are confined almost entirely to the stocks. It thus becomes necessary to assume an influence of scion upon stock which is not yet admitted by horticulturists. Under the circumstances it may be assumed with equal probability that the conditions of the experiment were such that a large variable factor was not brought under control. The Iowa experiment is further complicated by the fact that the plot of land in which the trees were planted had grown nursery stock some of which was affected with crown-gall, and that the plot is so located that it, or at least a part of it, received the wash from adjacent affected trees. Furthermore, the report does not state whether the trees were planted in such a way as to eliminate variations in soil and in growth conditions. It must be remembered in this connection that in average orchard planting the chance of infection after the trees are permanently set is very small.

[5] Greene, Laurenz, and Melhus, I. E. The effect of crown gall upon a young apple orchard. Iowa Agr. Exp. Sta. Research bul. 50:145–176. 1919.

[6] Swingle, D. B., and Morris, H. E. Crown-gall injury in the orchard. Montana Agr. Exp. Sta. Bul. 121:123–139. 1918.

The crown-gall disease seems to have been much more prevalent in New York some fifteen or twenty years ago than it is at the present time. There was much more agitation about the disease at that time, but this may be accounted for in part by the fact that inspection service for San José scale was being instituted and enforced, and that this inspection involved also examination for and rejection of trees having crown-gall. Aside from this, however, one of the writers (S), who was interested in diseases of nursery trees, recalls that in 1909 the fields in one large nursery from which apple trees had been dug were thickly strewn with trees that had been rejected at digging time because of crown-gall.[7] It was this condition, in part, that led to the experiments herein reported. But in 1910, when trees were sought for the experiments, very few were to be found and there was some difficulty in procuring the necessary stock. This condition has prevailed in subsequent years. One factor in nursery management may have contributed to this desirable condition, namely, that there has been an increasing tendency on the part of the nurserymen to grow trees in rotation with farm crops, thus allowing for the death of *Bacterium tumefaciens* in the soil or on plant parts. Another factor which may be involved is that most apple trees in New York are budded on French stock. One of the writers (S)[8] has expressed the opinion that French-grown stock is less susceptible to crown-gall than is American-grown stock, and it seems obvious that the practice of budding in the field, which is the common practice in New York, gives less opportunity for widespread infection than does that of bench grafting.

PLAN OF THE CROWN-GALL EXPERIMENT

In order to determine, if possible, the importance of crown-gall on apple and peach trees under the conditions existing at Ithaca, New York, an experiment was planned, the details of which were as follows:

The land for the experiment lay in a low field which had been in grass for a number of years previously. There are hills on all sides, but there is suitable drainage so that the soil is never too wet for good growth. The soil is a good loam, running out into stony loam on the side where the rows are marked *A* in figure 1. The soil is suitable for the growth of both apples and peaches, but the location is unsuited for peaches. Peaches are grown successfully a few miles from Ithaca, but there is little chance of securing crops in the immediate vicinity, chiefly because of low temperature in the winter. This was not fully realized at the beginning of the experiment.

The land was ploughed and cultivated each year and a sown cover crop usually was employed.

[7] It is likely, though, that some of these trees bore galls produced by an aphis (*Schizoneura lanigera*), and this is the opinion expressed by one large nurseryman.

[8] Stewart, V. B. Exclusion legislation and fruit tree production. Phytopath. 8:360–364. 1918. (The citation refers to page 362.)

THE EXPERIMENT WITH APPLES

Apple trees, of several varieties, bearing evident lesions of crown-gall were procured in the autumn of 1910. On April 20, 1911, photographs were made of the trees[9] and the trees were set in the garden. On May 6, healthy trees were procured, photographs were made, and the trees were interspersed with the diseased trees as shown in the accompanying plan (figure 1). All the trees were two years from the bud and were on imported French stock. Practically all of them, except for the galls, would

	1	2	3	4	5	6	7	8	9
A	**S**	**We**	**S**	**We**	**S**	We	**S**	**We**	**S**
B	**We**	**TO**	**We**	TO	**We**	**TO**	Wa	**TO**	**Wa**
C	**B**	**Wa**	**B**	**Wa**	B	**A**	**B**	**Wa**	**K**
D	**Wa**	**WR**	**Wa**	**WR**	**Wa**	**K**	WR	**K**	K

FIGURE 1. PLAN OF THE APPLE CROWN-GALL EXPERIMENT

Each character represents a tree and indicates the name of the variety according to the following key: *A*, Alexander; *B*, Baldwin; *K*, Tompkins King; *S*, Northern Spy; *TO*, Twenty Ounce; *Wa*, Wagner; *We*, Wealthy; *WR*, Wolf River. Bold-face letters represent galled trees; light-face letters represent healthy trees

have been graded as best-quality trees. The notable exception is tree C-6, variety Alexander, which was small in diameter and bore a very large gall at the crown.

The trees were pruned very lightly from year to year, and in all cases the pruning consisted in the entire removal of undesirable limbs or branches. No heading-back was done.

A record of the general appearance of the trees was made twice each year, always without notes of the previous condition. For the most part the records are normal and may be tabulated without comment. One tree, C-3, was girdled by mice in the winter of 1913-14. A renewal developed but was winterkilled the following winter. The tree was removed on May 28, 1915, when it was found that the galls had enlarged appreciably (figure 2). The record of this tree previous to injury is shown in table 1.

The records for the apple trees are given in table 1. Before examining the records or deriving any conclusion, the reader should have in mind a number of items. (1) It is now evident that the experiment was not planned on a large enough scale to give the best results, and particularly there were not enough healthy trees planted for comparison. This was not an oversight on the part of those planning the experiment, but rather

[9] The photographs are on file in the Department of Plant Pathology at Cornell University under the number 5727. None is reproduced here because the negatives are uniformly poor and suitable reproductions cannot be made. Camera and plates were tested in order that uniformly good photographs might be obtained without waiting to develop the negatives. When all negatives were found to be uniformly bad, it appeared probable that the shutter of the camera had been tampered with in the interim. The original negatives show the location and size of the galls very readily, and they proved most useful when the trees finally were removed.

was due to space limitations. (2) The varieties employed in the test were so numerous and the growth habits so different that comparisons between varieties would lead to error. On the other hand, the number of trees of any one variety was scarcely large enough to allow for satisfactory comparisons. (3) The yield of the trees was expected to give quantitative data. The trees had only just come into bearing, and so these data were not obtainable at the time when, of necessity, the experiment was terminated. It is not likely that the data would have been of sufficient

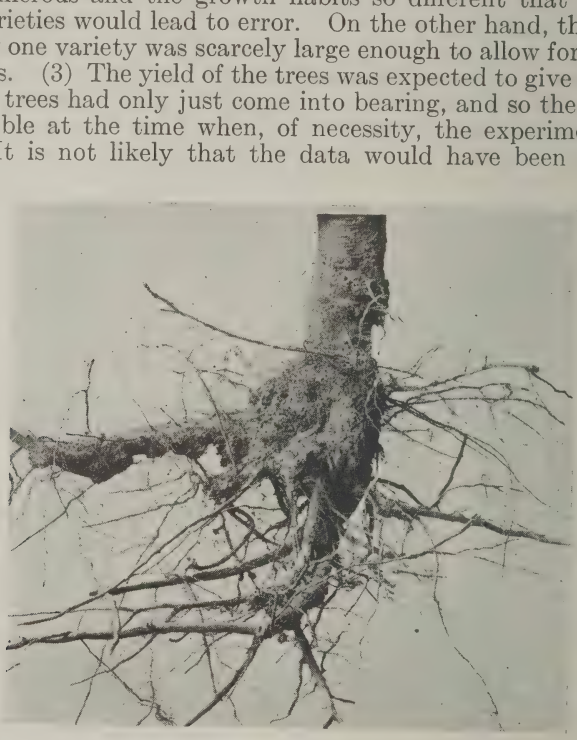


FIGURE 2. BALDWIN TREE C-3

The galls had increased somewhat in size, but there was no indication that they had interfered with the development of the tree

extent to be very reliable. (4) The apple-tree borer (*Saperda candida*) proved a great pest. Sometimes as many as six larvae were found in a single tree. If these larvae are removed, little injury will follow; but if one or two are missed—and this apparently is almost inevitable—great damage may be wrought within a few weeks. Most of the fluctuations in general appearance of trees from year to year, without question, are attributable to this borer. (5) Frost, rabbits, mice, and other fortuitous circumstances reduced the size of some trees so that, with the small numbers involved, it did not seem worth while at the end even to weigh the trunks and the crowns, although this could have been done very easily.

TABLE 1. ANNUAL RECORD OF GROWTH AND DEVELOPMENT OF HEALTHY APPLE TREES AND OF TREES AFFECTED WITH CROWN-GALL

(The trees were set in the spring of 1911 and records were made from 1912 to 1919 inclusive. The final record was made on May 20, 1920. In examining the trees for general condition and appearance, four classes were recognized: *e*, excellent; *g*, good; *f*, fair; *p*, poor. Healthy trees are designated by an asterisk)

Variety	Location	General condition of growth for the respective seasons								Condition of roots at digging time
		1912	1913	1914	1915	1916	1917	1918	1919	
Northern Spy..	A-1	p	p	f	g	f	f	f	e	g. No gall
Northern Spy..	*A-3	f	g	e	e	e	e	e	e	e. No gall
Northern Spy..	A-5	g	g	e	e	e	e	e	e	e. No gall
Northern Spy..	A-7	f	g	e	e	e	e	e	e	f. Hard gall at crown, size of a liter flask
Northern Spy..	A-9	g	g	e	e	e	e	e	e	g. No gall
Wealthy.....	A-2	f	g	g	g	g	g	g	e	g. Small galls on one large root
Wealthy.....	A-4	g	g	e	e	e	e	e	e	g. Two small hard galls at crown; small galls on two roots with hairy root
Wealthy.....	*A-6	f	g	e	e	e	e	e	e	g. No gall
Wealthy.....	A-8	g	g	e	e	e	e	e	e	e. No gall
Wealthy.....	B-1	e	g	g	g	g	g	g	e	e. No gall
Wealthy.....	B-3	e	g	e	g	...[1]	.....	.....	.....	.....
Wealthy.....	B-5	f	f	f	f	f	f	f	f	e. One hard gall (egg) on trunk; smaller galls on several roots
Twenty Ounce..	B-2	e	e	e	e	e	e	e	e	e. No gall
Twenty Ounce..	*B-4	f	g	g	e	e	e	e	e	e. No gall
Twenty Ounce..	B-6	e	g	e	e	e	e	e	e	Broken off at crown
Twenty Ounce..	B-8	g	g	....	e	e	e	e	e	g. No gall
Wagner.....	*B-7	f	g	e	e	e	e	e	e	g. No gall
Wagner.....	B-9	f	g	....	g	e	g	e	e	g. No gall
Wagner.....	C-2	g	g	e	e	e	e	e	e	e. No gall
Wagner.....	C-4	f	g	e	g	g	g	g	e	g. Remnant of hard gall in crown; small galls (egg) on two roots
Wagner.....	C-8	g	g	f	f	g	f	g	f	g. Hard gall (egg) in crown and on one root; small gall on one root
Wagner.....	D-1	g	g	g	e	e	e	e	e	g. No gall
Wagner.....	D-3	e	e	e	e	e	e	e	e	g. No gall
Wagner.....	D-5	g	g	e	e	e	e	e	e	g. One small (metastatic?), recent, hard gall on trunk above ground
Baldwin.....	C-1	g	g	e	e	e	e	e	e	e. No gall
Baldwin.....	C-3	g	g	...[2]	.....	.....	.....	.....	.....	.....
Baldwin.....	*C-5	e	e	e	e	e	e	e	e	g. No gall

[1] Girdled by borer; removed October 11, 1916; gall in crown 8 centimeters in diameter.
[2] Girdled by mice; removed May 28, 1915; gall enlarged. (See figure 2.)

TABLE 1 (*concluded*)

Variety	Location	General condition of growth for the respective seasons								Condition of roots at digging time
		1912	1913	1914	1915	1916	1917	1918	1919	
Baldwin	C-7	g	g	g	g	g	g	g	f	g. No gall
King	C-9	e	g	e	e	e	e	e	e	g. Hard gall (egg) at surface of ground
King	D-6	g	e	e	e	e	e	e	e	g. No gall
King	D-8	e	g	e	e	e	e	e	e	e. No gall
King	*D-9	f	g	e	e	e	e	e	e	g. No gall
Wolf River	D-2	e	e	e	e	e	e	e	e	e. Doubtful galls on a few small roots
Wolf River	D-4	e	e	e	e	e	e	e	e	e. Small gall (egg) in crown
Wolf River	*D-7	e	e	e	e	e	e	e	e	e. No gall; stock enlarged (natural?)
Alexander	C-6	e	e	e	e	e	e	e	e	e. Stock enlarged on one side; hard gall present

The trees were removed on May 24, 1920. About two-thirds of them were pulled by hitching a team directly to them; the remainder were pulled with blocks. There was not the least indication that gall-free trees pulled more easily than those originally bearing galls. One tree, B-6, broke off at the surface of the ground, but this seems to have been due to weakening from borers and to the large size of the roots.

On examining the roots it could not be detected, from their appearance, size, or length, that there was any difference between the roots of galled trees and those of trees free from galls. The most surprising thing revealed by examination of the roots was that in many instances the original galls had disappeared completely. This was true in practically all cases in which the original tree had a long rootstock and the gall was located near the base of the stock. All the main roots issued from the stock near the surface of the ground, due perhaps to the nature of the subsoil. In most cases in which the gall was located on a lateral root, both root and gall had disappeared, but the same disappearance of original roots was noted in healthy trees also.

Summary for the apple experiment

The data in table 1 may be summarized in a few words. In no case is there indication that the presence of crown-gall on the roots of these apple trees interfered in any way with growth. The galls had largely

disappeared, and judging by this test the crown-gall disease on apples seems, in this locality, to be chiefly a matter of concern to the nurseryman.

Even in the nursery it is not certain that the disease is of great consequence for apples. It will be noted that most of the trees used in the test were of a size to be graded first-class. Galled nursery trees have been seen that were short and very small in diameter, and the natural inference is that the presence of the disease accounted for the size of the tree. It is to be remembered, however, that trees of small caliper are not uncommon in the nursery even when no disease is present. Tree C-6 of the experiment is of this sort, and its behaviour when planted in the orchard is of particular interest. Two companion trees of C-6 were rejected for the experiment because their dwarfed condition obviously made them unfair to the test. One of the writers (R) planted these two trees in deep sandy loam on private land. Both trees have made excellent growth, and as they were top-worked to early-maturing varieties both have borne crops of fruit. One tree was removed in 1922 to make way for a building. There was no evidence of the original gall or of subsequent infection. The other tree is larger than some others that were set in the immediate vicinity two years earlier.

In connection with the outcome of this experiment the experience of a well-known horticulturist is of interest. The following extract is taken from an article by C. A. Green, for many years editor of *Green's Fruit Grower*. The article appeared in the issue of that journal for May, 1912. The orchard mentioned in the article is located twelve miles southwest of Rochester, New York, and is of special interest because it is in the main apple belt of western New York.

> Here is something that I want to call particular attention to. There is much said in these days about root gall on apple trees. At the time I planted this orchard but little was known about root gall. As I planted the trees with my own hands I noticed that occasionally a tree had a knotty excrescence on the roots which I now would recognize as root gall, and which is now regarded as infectious and fatal to the growth or welfare of the trees. Here is an interesting point which I desire to allude to: after growing for over thirty years and bearing fruit abundantly for over fifteen years, every tree in this orchard is healthy and one tree is as productive as another, and yet a number of these trees were infested with root gall. If the views of the experiment station are correct, the trees I planted thirty years ago, which were then affected with root gall, should long ago have perished or should have shown some signs of disease. That the trees are now all healthy and productive, teaches me that we have something yet to learn about root gall on apple trees.

THE EXPERIMENT WITH PEACHES

In the spring of 1911 a quantity of peach trees bearing evident lesions of crown-gall were procured from New York nurserymen. On April 6, 1911, photographs were made and the trees were set in the diseased garden as indicated in figure 3. Healthy trees were obtained in a separate shipment. The healthy trees were prepared for planting by one man, who used all antiseptic precautions. They were planted before the general lot of

infected trees, in order to avoid any contamination. All the trees were one year from the bud and were on peach stock. They were interplanted in the block of apples so that the whole block was on the quincunx plan with trees ten feet apart in the rows.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
A	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
B		B		B		B		B		B		B		B		B		B	B
C	B	B	B	B	C	C	C	C	C	C	C	C	C	E	C	C	C	C	
D		C		C		C		C		C		E		C		C		C	C
E	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
F		E		E		E		E		E		E		E		E		E	E
G	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
H		F		F		F		F		F		F		F		F		F	B

FIGURE 3. PLAN OF THE PEACH CROWN-GALL EXPERIMENT

Each character represents a tree and indicates the name of the variety according to the following key: *B*, Belle of Georgia; *C*, Carman; *E*, Elberta; *F*, Foster. Bold-face letters represent galled trees; light-face letters represent healthy trees

A great many of the trees failed to start growth when set, with the result that twenty-eight of the original ninety-eight affected trees were removed the first year. All of the affected trees of the variety Foster succumbed early. This may not be significant, because the original source and the treatment of these trees are not definitely known. From the high percentage of failures the first summer, it would appear that the crown-gall disease may be a factor in securing a good stand. This could be determined readily, but, unfortunately for the experiment, the crown-gall disease has been very scarce on peaches as well as on apples in New York nurseries since 1910, and doubtless for the same reason.

The winter of 1911-12 was severe, and winter sun-scald was abundant not only in the experimental block but throughout western New York. The loss from winter injury might be ascribed conveniently to a weakened condition of the trees due to the presence of crown-gall. The record shows, however, that 53 per cent of the healthy trees showed this injury, whereas only 20 per cent of the diseased trees were injured in this way. Furthermore, the winter of 1910-11 also was exceedingly severe for fruit trees of all kinds. Nurserymen generally were called on to replace many of the trees set in the spring of 1911. One firm alone replaced 20,000 peach trees out of a season's business of perhaps 300,000 trees. This may mean that two or three times the number replaced actually died, since, as a rule, not many persons demand replacement. For the most part the injury to the experimental trees occurred above the snow line, so that new growth started below the frost canker and above the point of union of scion with stock. Even when the renewal came from below the union, the tree was allowed to stand, since the development of the galls should be approximately the same.

In subsequent years many of the trees made excellent growth, as is shown in table 2, but each winter the temperature was low enough to kill fruit buds or else the buds were forced by a period of warm weather in late winter and then killed by frost.

The larvae of a borer (*Sanninoidea exitiosa*) gained entrance to a number of the trees in the late summer of 1913. As they were not noted until the following year, the number of trees showing effects of borer injury in 1914 is relatively large. The foliage of affected trees was slightly yellow (off color), was often somewhat rolled upward, and in some cases showed a marked tinge of red on the margins. Some of the borer channels extended far into the roots, and practically all of the trees removed on September 1, 1915, were injured primarily by borers. In some cases frost cankers were present, but these probably followed as a result of poor growth or immature wood consequent to borer injury.

Results of the peach experiment

From time to time the trees that were crowding, and especially those that were in poor condition, were removed. It was thus determined that borers were chiefly blamable for the poor appearance of certain trees, and that for the most part the galls had disappeared entirely. In many cases the position of the original gall could be determined only with difficulty or not at all. Usually the position could be determined by the occurrence on the stock of an area having the appearance of a healed wound (Plate II).

No crop of fruit was obtained during the course of the experiment, and so the only record is on the general appearance of the trees and the condition of the roots at digging time. The condition of the trees from year to year is shown in table 2. The same general reservations mentioned for the apples (page 7) apply in the case of the peaches, although the exact reason for the reservation is not the same in every instance.

The trees still living in the spring of 1918 were pulled. Unfortunately they were removed without warning and were not left in their regular order. An attempt was made to compare the leafless trees with previous growth records, but there was so much uncertainty about this that it was abandoned. Examinations of the pulled trees bore out the condition indicated in the table, namely, that most of the galls had disappeared.

The most interesting outcome of the experiment is that no peach trees died from the effects of crown-gall, and, so far as can be determined, the disease did not affect the growth of the trees to any appreciable extent. For the most part, galls either disappeared or were relatively small and insignificant. In a few cases the whole stock of the tree seems to have been enlarged, but even in such cases there was no indication, from the general appearance and growth of the tree, that any injury had been done.

TABLE 2. ANNUAL RECORD OF GROWTH AND DEVELOPMENT OF HEALTHY PEACH TREES AND OF TREES AFFECTED WITH CROWN-GALL

(The trees were set in the spring of 1911 and records were made from 1912 to 1917 inclusive. The final record was made on May 20, 1918. In examining the trees for general condition and appearance, four classes were recognized: *e*, excellent; *g*, good; *f*, fair; *p*, poor. Healthy trees are designated by an asterisk)

Variety	Location	1911 Oct. 3	1912 Oct. 12	1913 Sept. 6	1914 Sept. 14	1915 Sept. 14	1916 Sept. 11	1917 Sept. 25
Belle of Georgia	A- 1	.....	.....[1]	.....	.....	.....	.....	....
Belle of Georgia	A- 2	.....	f	f	g	g	g	f
Belle of Georgia	A- 3	Dead[2]	.....	.....	.....	.....	.....	.....
Belle of Georgia	A- 4	.....	g	g	f	p[4]	.....	.....
Belle of Georgia	*A- 5	.....	e	g	g	g	e	e
Belle of Georgia	*A- 6	.....	e	g	g	g	e	e
Belle of Georgia	A- 7	.....	e[3]	g	g	g	e	e
Belle of Georgia	A- 8	.....	e	g	g	g	e	e
Belle of Georgia	A- 9	.....	e	g	g	g	e	e
Belle of Georgia	A-10	.....	e[3]	g	g	g	e	e
Belle of Georgia	A-11	.....	f	g	g	g	g[5]	.....
Belle of Georgia	A-12	Dead[2]	.....	.....	.....	.....	.....	.....
Belle of Georgia	A-13	.....	g	g	g	g	e	e
Belle of Georgia	A-14	.....	g	g	g	g	e	e
Belle of Georgia	A-15	.....	g	g	g	g	g	g
Belle of Georgia	A-16	.....	g[3]	g	g	g	f[6]	.....
Belle of Georgia	A-17	Dead[2]	.....	.....	.....	.....	.....	.....
Belle of Georgia	A-18	.....	e[3]	f	f	f[7]	.....	.....
Belle of Georgia	B- 1	.....	e[3]	e	g	g	g[3]	.....
Belle of Georgia	B- 2	.....	e	e	e	e	e	e
Belle of Georgia	*B- 3	.....	e	g	g	e	e	g
Belle of Georgia	*B- 4	.....	e	g	e	e	e[9]	.....
Belle of Georgia	B- 5	.....	e[3]	g	e	e	e	e
Belle of Georgia	B- 6	Dead[2]	.....	.....	.....	.....	.....	.....
Belle of Georgia	B- 7	.....	g	g	e	g	g	e
Belle of Georgia	B- 8	Dead[1]	.....	.....	.....	.....	.....	.....
Belle of Georgia	B- 9	.....	e	g	e	g	e	e
Belle of Georgia	B-10	Dead[2]	.....	.....	.....	.....	.....	.....
Belle of Georgia	H-10	.....	e	e	e	f	g[10]	.....
Belle of Georgia	C- 1	.....	....[1]	.....	.....	.....	.....	.....
Belle of Georgia	C- 2	.....	e	g	g	g	g	f
Belle of Georgia	C- 3	.....	e	g	e	e	g	g
Belle of Georgia	C- 4	.....	e	g	g	e	e	e
Carman	*C- 5	.....	e	g	g	e	e	g
Carman	C- 7	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	C- 8	.....	p[3]	g	g	f[11]	.....	.....

[1] Did not survive the winter.
[2] Failed to grow, or a few weak shoots pushed and then died.
[3] Girdled by frost; a new shoot developed from below the snow line.
[4] Removed September 1, 1915; winter injury; gall inactive, small.
[5] Removed October 11, 1916; crowding; good roots; crown considerably enlarged; several small galls.
[6] Removed October 11, 1916; roots fair; one small gall in crown; severe borer injury.
[7] Removed September 1, 1915; winter injury; gall disappeared.
[8] Removed October 11, 1916; excellent roots; large galls on crown; one gall 2 centimeters in diameter on one root.
[9] Removed September 11, 1916; excellent roots; no galls.
[10] Removed September 11, 1916; root system fair; crown somewhat enlarged but gall practically disappeared.
[11] Removed September 1, 1915; severe borer injury; gall disappeared.

TABLE 2 (*continued*)

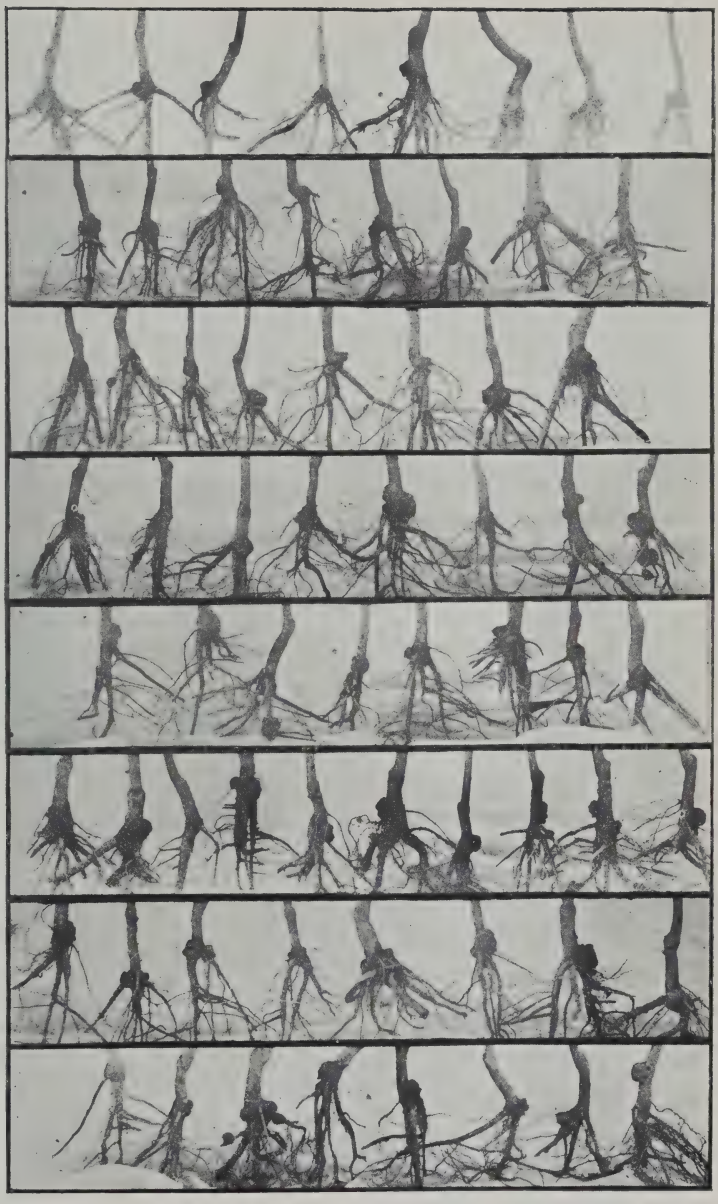
Variety	Location	1911 Oct. 3	1912 Oct. 12	1913 Sept. 6	1914 Sept. 14	1915 Sept. 14	1916 Sept. 11	1917 Sept. 25
Carman	C- 9	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	C-10	.....	f	g	f	g	g	g
Carman	C-11	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	C-12	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	C-13	.....	g	g	f	e	e	e
Carman	C-15	.....	g	g	f	f[12]	.....	.....
Carman	C-16	.....	e	g	g	g[13]	.....	.....
Carman	C-17	.....	e	e	e	e	e	e
Carman	C-18	.....	f	g	p[14]	p[15]	.....	.....
Carman	D- 1	.....	e	e	e	e	e[16]	.....
Carman	D- 2	.....	g	g	e	g	e	e
Carman	D- 3	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	D- 4	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	D- 5	.....	Dead[1]	.....	.....	.....	.....	.....
Carman	D- 7	.....	e	e	e	e	e	e
Carman	D- 8	.....	f	p[14]	p	p	.....[18]	.....
Carman	D- 9	.....	g	g	g	e	e	e
Carman	D-10	.....	p[19]	g	....[20]	.....	.....	.....
Carman	E- 1	.....	g	g	e	g	e	f
Carman	E- 2	.....	g	e	e	e	e	e
Carman	E- 3	.....	p[3]	g	e	e	e[21]	.....
Carman	E- 4	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	E- 5	.....	e	e	e	e	g[22]	.....
Carman	E- 6	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	E- 7	.....	e	e	e	e	e	e
Carman	E- 8	.....	e	g	p	p	p[23]	.....
Carman	E- 9	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	E-10	.....	g[3]	e	e	e	e	g
Carman	*E-11	.....	g	e	g	e	e	e
Carman	*E-12	.....	e	e	e	e	e	e
Carman	E-13	.....	e	e	e	e	e	e
Carman	E-14	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	E-15	Dead[2]	.....	.....	.....	.....	.....	.....
Carman	E-16	.....	g	f	p[14]	f[24]	.....	.....
Carman	E-17	.....	e	g	g	f[25]	.....	.....
Carman	E-18	.....	g	g	g	e	e	e
Elberta	*C- 6	.....	g	g	g	g	e	g

[12] Removed September 1, 1915; severe borer injury; gall disappeared; two galls on roots; hairy root above crown.
[13] Removed September 1, 1915; original gall disappeared; three galls (walnut) on one root.
[14] Borer injury.
[15] Removed September 1, 1915; original gall disappeared; one gall 1 centimeter in diameter on one root.
[16] Removed October 11, 1916; gall disappeared; large tree, large root system.
[17] Removed October 11, 1916; root crown in bad condition, evidently from gall but complicated by severe borer injury; three small galls on roots.
[18] Missing, no record; severe borer injury previously.
[19] Injured by plow.
[20] Dead July 1, 1914; no record.
[21] Removed October 11, 1916; borer injury; several small galls.
[22] Removed October 11, 1916; borer injury severe; galls disappeared.
[23] Roots fair; three small galls and indications of hairy root.
[24] Removed September 1, 1915; original gall disappeared; one gall 1 centimeter in diameter on one root.
[25] Removed September 1, 1915; borer injury; gall disappeared; indication of hairy root.

TABLE 2 (*concluded*)

Variety	Location	1911 Oct. 3	1912 Oct. 12	1913 Sept. 6	1914 Sept. 14	1915 Sept. 14	1916 Sept. 11	1917 Sept. 25
Elberta	C-14	.....	f[3]	g	g	g	g[26]	.....
Elberta	D- 6	.....	f[3]	g	f	g	g[17]	.....
Elberta	F- 1	.....	g	f	p[27]	.....	.....	.....
Elberta	F- 2	.....	g	g	e	e	e	e
Elberta	F- 3	Dead[2]	.....	.....	.....	.....	.....	.....
Elberta	F- 4	Dead[2]	.....	.....	.....	.....	.....	.....
Elberta	F- 5	.....	f	f	f	f[28]	.....	.....
Elberta	F- 6	.....	e[3]	g	e	e	e	e
Elberta	F- 7	Dead[2]	.....	.....	.....	.....	.....	.....
Elberta	F- 8	.....	e	g	e	f[29]	.....	.....
Elberta	F- 9	Dead[2]	.....	.....	.....	.....	.....	.....
Elberta	F-10	.....	g	g	g	f	f	f
Elberta	G- 1	.....	f	f	e	g	g	e
Elberta	G- 2	Dead[2]	.....	.....	.....	.....	.....	.....
Elberta	G- 3	Dead[2]	.....	.....	.....	.....	.....	.....
Elberta	G- 4	.....	e	e	g	e	e	e
Elberta	G- 5	.....	e	e	g	g	e	e
Elberta	G- 6	.....	e	e	g	e	e	e
Elberta	G- 7	.....	g	e	e	e	g	e
Elberta	G- 8	.....	e	e	g	e	g	f
Elberta	G- 9	Dead[2]	.....	.....	.....	.....	.....	.....
Elberta	G-10	.....	g[3]	g	f	g	f[30]	.....
Elberta	*G-11	.....	g[3]	f	p[14]	p[31]	.....	.....
Elberta	*G-12	.....	g[3]	g	g	f	p[32]	.....
Elberta	G-13	.....	e	g	g	g	e	e
Elberta	G-14	.....	g[3]	g	p[14]	f	p[33]	.....
Elberta	G-15	.....	g[3]	g	g	g	e	e
Elberta	G-16	.....	g	g	g	f	e	e
Elberta	G-17	.....	e	g	f	f	e	e
Elberta	G-18	.....	g	f	g	f	g[34]	.....
Elberta	H- 8	Dead[2]	.....	.....	.....	.....	.....	.....
Elberta	H- 9	Dead[2]	.....	.....	.....	.....	.....	.....
Foster	H- 1	Dead[2]	.....	.....	.....	.....	.....	.....
Foster	H- 2	Dead[2]	.....	.....	.....	.....	.....	.....
Foster	H- 3	Dead[2]	.....	.....	.....	.....	.....	.....
Foster	H- 4	Dead[2]	.....	.....	.....	.....	.....	.....
Foster	H- 5	Dead[2]	.....	.....	.....	.....	.....	.....
Foster	*H- 6	.....	e[3]	g	g	f	g[35]	.....
Foster	*H- 7	.....	e	e	e	e	e	e

[26] Removed October 11, 1916; no record.
[27] Removed July 1, 1914; poor location and practically dead.
[28] Removed September 1, 1915; frost injury; gall disappeared.
[29] Removed September 1, 1915; injured by frost and borers; old gall not apparent.
[30] Removed September 11, 1916; borer injury; roots good; large galls, 6 to 7 centimeters in diameter, on crown and roots.
[31] Removed September 1, 1915; injured by borers and frost; practically dead.
[32] Removed September 11, 1916; severe borer injury; no galls.
[33] Removed September 11, 1916; borer injury severe; roots small; three small galls.
[34] Removed September 11, 1916; borer injury severe; one small gall.
[35] Removed September 11, 1916; recovering from severe borer injury; no galls.


Row A
Trees 1 to 4, and 10, 7, 8, 9
Row A
Trees 11 to 18
Row B
Trees 1, 2, and 5 to 10
Row C
Trees 1 to 4 and 7 to 10
Row C
Trees 11 to 18
Row D
Trees 1 to 10
Row F
Trees 1 to 5 and 8 to 10
Row G
Trees 18 to 13, 10, and 9

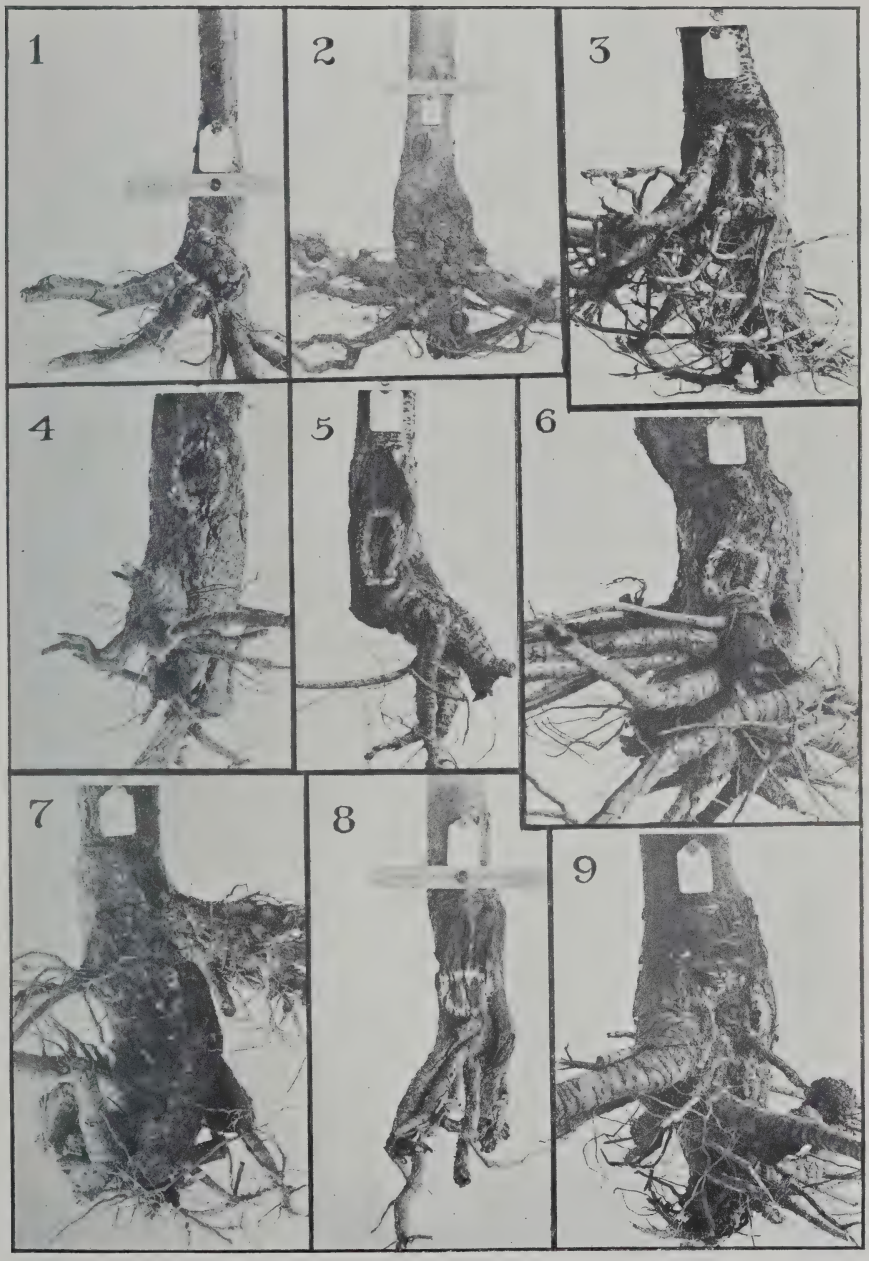
ROOTS OF THE PEACH TREES AFFECTED WITH CROWN-GALL WHICH WERE USED IN THE EXPERIMENT

The behavior of these trees in the field is shown in table 2. In each case read from left to right except in the row at the top, where tree 7 is tree 10 of the records and trees 8, 9, and 10 are 7, 8, and 9 of the records; and in the row at the bottom, where it is necessary to read from right to left. (Special acknowledgment is made to Mr. W. R. Fisher for his technical skill in obtaining suitable prints from most unsatisfactory negatives)

Plate II. Roots of peach trees from the crown-gall experiment

The condition of most of the roots at the time of setting is shown in Plate I, and a record of behavior previous to digging is given in table 2. In cases in which the original gall has disappeared, its location is outlined with chalk

1, Tree A-4. Removed September 1, 1915, because of winter injury. Gall apparently inactive
2, Tree A-11. Removed October 11, 1916, because of crowding. Crown considerably enlarged and several small galls, but tree apparently in good condition
3, Tree E-16. Removed September 1, 1915. A small gall at base of root issuing from near bottom of original gall
4, Tree A-18. Removed September 1, 1915, because of winter injury
5, Tree F-5. Removed September 1, 1915, because of frost injury. Gall disappeared, and no indication that it could have been a factor in decline of tree
6, Tree F-8. Removed September 1, 1915, because of injury by frost and borers
7, Tree G-11. Removed September 1, 1915, because of severe injury by frost and borers
8, Tree C-18. Removed September 1, 1915. Original gall disappeared
9, Tree C-16. Removed September 1, 1915. Original gall disappeared. Three new galls have appeared, two of which show clearly in the photograph



ROOTS OF PEACH TREES FROM THE CROWN-GALL EXPERIMENT

(See legend opposite)

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GENERAL CONSIDERATIONS

Field experimentation is very unsatisfactory at best, because so many uncontrollable factors are involved which interfere with a correct interpretation of results. This condition has come to be rather generally understood, the recent analyses by Harris[10] of results from field plot tests, and by Anthony and Waring[11] for orchard tests, only serving to indicate how generally unreliable such data are. In addition to the usual vicissitudes encountered in plot testing, an additional set of variables is added when one attempts to compare plants in health and in disease. Means have been devised for overcoming heterogeneity in field plots, but not enough is known about plant responses under conditions of parasitism to make suitable corrections. This is particularly true in the case of the disease under consideration, because Smith has shown that the response to the stimulus of *Bacterium tumefaciens* depends a great deal on the particular tissue affected. This individual variation can be eliminated by increasing the number of plants under test. The number of plants involved in a wholly satisfactory experiment obviously should be considerably greater than was included in this experiment, and the arrangement should be different.

The general indication, however, is that under the conditions of this experiment, crown-gall is not a factor in the growth and development of either apple or peach trees.

The agitation among fruit growers in regard to crown-gall has practically disappeared, doubtless due to the inspection service which causes rejection of trees bearing galls. The writers, however, in 1914 received a consignment of 400 apple trees, of which 28 (7 per cent) bore definite lesions of crown-gall. All of these were planted on private land and their exact location was recorded. While it is likely that many growers treat galled trees just as the writers did, it is to be recalled that the amount of crown-gall on nursery stock has not been large, and the rejection of trees on account of crown-gall has not been a serious loss to nurserymen.

The rôle of crop rotation in reducing losses from crown-gall in the nursery is an interesting phase of the problem, on which, unfortunately, experimental data are too meager to warrant any conclusions.

[10] Harris, J. Arthur. Practical universality of field heterogeneity as a factor influencing plot yields. Journ. agr. res. 19:279–314. 1920.

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BIOLOGICAL STUDIES OF BACTERIUM TUMEFACIENS

There are a number of biological problems connected with an investigation of crown-gall which are of considerable practical importance. One of the writers (S) was engaged in such work. He had undertaken an extensive series of tests designed to determine the longevity of the crown-gall organism in pure and in mixed culture, and under a variety of conditions. These were not completed when his connection with the institution was severed, and there was no opportunity to finish them before his untimely death intervened. The data accumulated are fragmentary, but their significance warrants publication at this time. They are given in the following paragraphs.

FIGURE 4. CROWN-GALL ON TOMATO PLANT

The cultures of *Bacterium tumefaciens* recovered in the studies on vitality were tested in this way in order to confirm identification

Persistence of B. tumefaciens in sterilized soil.— In order to determine the persistence of the crown-gall organism in sterilized soil, the following experiment was begun on November 10, 1914. Fifteen small pots were filled with loamy soil and sterilized. Five cubic centimeters of a bouillon culture of *B. tumefaciens*, four days old, was added to each pot. Twelve test tubes were partially filled, some with loam, others with quartz or clay, and to these one cubic centimeter of the culture was added. After four days all pots and tubes were tested to determine the presence in living condition of the organism (figure 4). All were then placed in a box out of doors. On January 2, 1915, the organism was recovered from clay, loam, and quartz. On April 14, 1915, a test of the loam soil in the test tubes showed the organism to be present in a living condition. Again on May 24, 1915, the organism was found to be alive in a pot of loam and in a tube of quartz. The next test was made on September 14, 1915. The organism was not recovered from either pots or tubes.

Persistence in unsterilized soil.—Experiments similar to the preceding were instituted with clay, loam, and quartz which had not been sterilized. As this was the most important series from the practical standpoint, it is unfortunate that data on the outcome cannot be found among Dr. Stewart's notes.

Moisture relation.—On February 24, 1914, tests were instituted to determine the vitality of *B. tumefaciens* in dry, moist, and saturated clay, loam, and quartz. Sterilized material in test tubes was used, and the tubes were constantly covered with a bell glass to prevent evaporation. On March 11, 1914, the organism was alive in all nine tubes. On April 10, 1914, the three tubes of dry material were tested and the organism was recovered. In a duplicate set of tubes which were not covered, the organism was dead on the latter date in the dry clay and the dry quartz. All the protected tubes were tested on November 18, 1914, and *B. tumefaciens* was found to be alive except in the tubes of dry clay and dry quartz. Sterilized wheat seeds were planted in some of the tubes of moist loam on April 17. The seeds grew and developed into plantlets. On May 29 a test was made of these tubes and *B. tumefaciens* was found to be alive.

Penetration of soil.—Tubes were filled with moistened quartz and with moist loam, and were sterilized. Five cubic centimeters of a culture of *B. tumefaciens* was poured into one end of each tube, and enough sterilized water was added so that water would drip from the other end. This was caught under aseptic conditions, and at the end of forty-eight hours was tested by plating. The organism was recovered from tubes 60 centimeters in length. No greater lengths were tested, as 60 centimeters represents the approximate penetration into the soil of roots of young trees. Similar tests with clay gave penetration in some instances and not in others. Apparently, if the clay became "puddled" from adding water too rapidly, the organism was filtered out.

While these tests are not extensive, they certainly indicate that, when free from competition, *B. tumefaciens* can live for several months in moist soil of various types, that it can withstand low temperatures and repeated change in temperature at or near the freezing point, and that it may move considerable distances with currents of soil water.

Memoir 67, *Observations on the Life History of Taphrocerus gracilis (Say) (Beetle, Family Buprestidae)*, the sixth preceding number in this series of publications, was mailed on September 14, 1923.

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